Q. Please provide the following information for Muskrat Falls:

a. A study of original O&M costs versus projected

b. A listing of all contractors anticipated to be used in the future and the tasks they will perform

c. The asset management plan for the site

d. Any studies that were performed to analyze O&M expenses

e. Any preventative maintenance programs developed for the plant

f. A copy of the plants work management process

g. A copy of any maintenance metrics projected to be monitored including preventative maintenance ("PMs"), corrective maintenance ("CMs"), and schedule adherence statistics.

h. The forecast overtime statistics for operations and the maintenance staff now and projected

i. A copy of any significant maintenance contracts in place or projected

j. A copy of any cost benchmarking studies performed

A. a. Please refer to Nalcor's responses to PUB-Nalcor-050 and PUB-Nalcor-51, which addressed changes in original O&M costs to updates prepared in March 2018 and October 2018. PUB-Nalcor-050, Attachment 2, "LCP 2019-2021 O&M Estimates Supporting Details 24-Oct-2018", page 30 addresses Muskrat O&M changes from March 2018 to October 2018. Also refer to Nalcor's response to PUB-Nalcor-81 for further clarification on this matter.

b. Please refer to PUB-Nalcor-050, Attachment 2, "LCP 2019-2021 O&M Estimates Supporting Details 24-Oct-2018", page 32. Related contractors anticipated to be used, scopes of work and detail specifications are currently

being developed with due consideration of the *Public Procurement Act* and any existing contracts supporting current operations (e.g., CFLCo and Hydro). So as to achieve reliability and least cost arrangements.

c. The Muskrat Falls (MF) Asset Management Plan is generally the same as applied by Hydro (including CFLCo) and in line with the Nalcor corporate standards. Please refer to the following:

- PUB-Nalcor-174, Attachment 1: "Corporate Business System - ERP Assessment Business Process Document Bills of Materials - Asset Management," December 20, 2016;
- PUB-Nalcor-174, Attachment 2: "Corporate Business System - ERP Assessment Business Process Document Create and Manage Equipment Records," December 2016;
- PUB-Nalcor-174, Attachment 3: "Corporate Business System - ERP Assessment Business Process Document Maintenance Work Centers - Asset Management," December 20, 2016;
- PUB-Nalcor-174, Attachment 4: "Corporate Business System - ERP Assessment Business Process Document Planning - Asset Management," September 12, 2018;
- PUB-Nalcor-174, Attachment 5: "Corporate Business System - ERP Assessment Business Process Document - Asset Management Preventive Maintenance PAAR Level 1," August 14, 2018;
- PUB-Nalcor-174, Attachment 6: "Corporate Business System - ERP Assessment Business Process Document Work Order Prioritization Asset Management," August 10, 2018;

- PUB-Nalcor-174, Attachment 7: "Corporate Business System - ERP Assessment Business Process Document Scheduling - Asset Management," August 14, 2018; and
- PUB-Nalcor-174, Attachment 8: "Corporate Business System - ERP Assessment Business Process Document WO Management- Asset Management," August 8, 2018.

d. A significant cost driver associated with O&M expenses are labour costs. The MF plant engaged and finalized a report on FTEs/staffing with Navigant, an external third party consulting firm (see j., below). In addition, management is considering engagement of a third party consultant to complete additional analysis on other O&M expenses.

e. The development of preventive maintenance programs is currently ongoing by the Asset Management Group, utilizing existing Nalcor entity practices, where appropriate.

f. The MF Plant Work Management asset process is generally the same as applied by Hydro (including CFLCo) and in line with the Nalcor corporate standards. Please refer to PUB-Nalcor- 174, Attachment 9.

g. Metrics, to be developed, will be based on corporate standards with adjustments based on assets in use.

h. There are no actual overtime statistics for operations and maintenance staff to report at this time. Current MF plant base year financial projections for

overtime are $193.5k based on 8% of salary costs which will be refined as time progresses and more detail budgets are prepared in cooperation with hiring of new plant management staff.

i. A listing of anticipated contracts were provided in Nalcor's response to PUB-Nalcor-050, Attachment 2, "LCP 2019-2021 O&M Estimates Supporting Details 24-Oct-2018" page 32. At this time, there are no signed contracts in place for operations of the MF plant but work is advancing to develop, as noted below, single source contracts based on the premise that the companies noted have specialized required knowledge:

- Turbine Service Contact - Andritz - general maintenance and technical support of turbines; Excitation Systems – ABB - general maintenance and technical support of excitation systems; Elevator Maintenance – Thyssen Krupp - general maintenance and technical support of elevator and hydraulic equipment in elevator pit; Trash Cleaning Machine Maintenance - Muhr - Trash cleaning machine on the reservoir; Water Monitoring along the Churchill River – Government of NL - monitoring various water stations for river flow and elevation metrics required for flood control; and
- Electrical Maintenance Agreement for Power lines (distribution) – Hydro - maintenance of power distribution system (poles, infrastructure, etc.).

Work is progressing to tender other contracts to support general maintenance on other systems in the MF plant, for example, overhead doors, snow clearing, janitorial, etc.

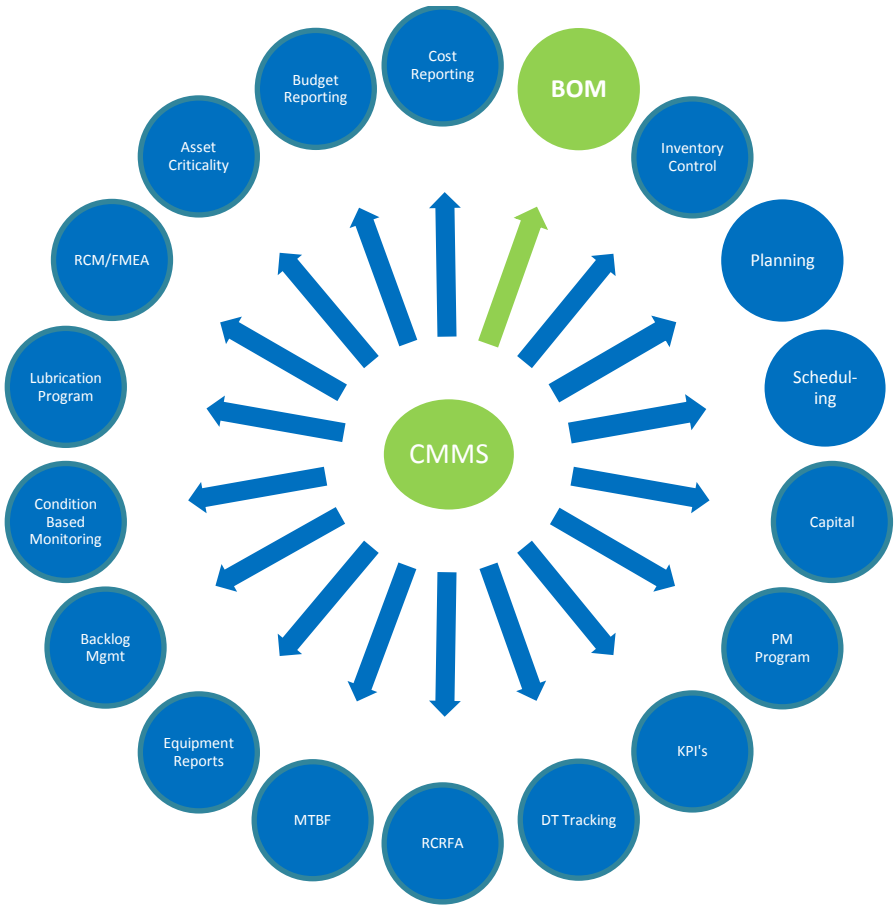
j. Work has been completed by Navigant, a third party consulting firm, to identify MF plant Staffing/FTE levels required to manage and support the plant. Please see attached PUB-Nalcor-174, Attachment 10.

Corporate Business System - ERP Assessment

Business Process Document

Bills of Materials - Asset Management

December 20th/2016



Version	Date	Description of Revision	Author
	2016-12-20	Updated after process review	S. McCarthy

Contents

Purpose

Spare parts are the lifeblood of operational reliability and plant capacity. No plant can operate at a high level of output without a reliable supply of functional spare parts. Efficient Maintenance planning requires detailed spare parts lists. Maintenance execution requires the right parts, in the right condition, at the right time. Yet, spare parts are often overlooked as a contributor to availability and reliability outcomes.

Spare Parts Management and an organized maintenance storeroom is one key process which supports effective maintenance planning and scheduling. Improved materials management and spare parts management will free up time for maintenance planners, maintenance supervisors, and hourly maintenance personnel. It is not unusual to see an average of 20-30% of maintenance crafts people's time to be used for finding parts and material.

This Bill of Materials (BOM) procedure contributes to the Materials Planning process and to the creation of efficient, effective and documented repair procedures for equipment through documenting the collective knowledge of the organization with regards to procedures, technical details, spare parts, and labour plans. Continually improving standard job plans and Planner resources such as equipment parts lists will improve Planner effectiveness and reduce downtime and work execution time.

The start of this process should be driven from the "Operational Readiness Process" and "Equipment Criticality process", which should assess what is needed to maintain the Equipment's reliability. The biggest failing of this process is often in its timing; it is at the time of Project / Construction that Equipment assessments and strategy should define parts, standard jobs, Preventive Maintenance / Condition Based Maintenance(PM/CBM) requirements. Often, consideration of making equipment ready to Operate and Maintain is not done before project handover and developing maintenance strategies and equipment data resources becomes a burden on Maintenance departments. Standard Nalcor Inventory procedure should be followed for the addition of items stored in Inventory as well as items that will be identified as ordered on demand.

Terminology

- *Bill of Materials (BOMs)*
    - *Bills of Material may be of two types, PM BOMs and Parts List BOMs*
        - *PM BOMs may contain both a Standard Parts List and Standard Instructions for a defined job. These Parts and Instructions are associated with a Model Work Order and a PM Service so that the Assigned Work Order Parts and Labour (Routings) are automatically created when the work order is created from the PM system.*
        - *Parts List BOMs contain only a Parts List associated with an equipment, and the Parts List BOM is attached to the equipment master record. When a Corrective WO is created for that equipment record, the WO Parts List may have the Parts*

List BOM copied onto the WO Parts List as a starting point for planning the materials requirements for the job.

- *In JD Edwards World software, the only way to assign a standard Parts List to an equipment record was by the use of a EPL BOM.*
- *All BOMs in JD Edwards World software require a virtual inventory item to be used as a header record to which the standard parts and/or standard PM labour are attached.*
- *In JD Edwards Enterprise One software, the same functionality exists for a BOM that is attached to a virtual Inventory Item header that is then attached to the equipment or a PM Model.*

- *Equipment Parts List (EPL)*
  - *In JD Edwards Enterprise One software, the functionality of the Parts List BOM has generally been replaced and enhanced by the use of Equipment Parts Lists, attached directly to the equipment record.*
  - *EPLs can contain stock and non-stock items the same as Parts List BOMs, but can also include non-catalogued items for which no SKU (Stock Keeping Unit or Inventory Item Number) has been created.*
  - *EPLs contain only a Parts List associated with an equipment, and the EPL is attached to the equipment master record. When a Corrective WO is created for that equipment record, the WO Parts List may have the EPL copied onto the WO Parts List in whole or in part in order to plan the materials requirements for the job.*
  - *Unlike Parts List BOMs, the EPL can have materials copied onto the WO Parts list on more than one occasion, and parts may be selected from EPLs associated with child equipment of the equipment number on the work order.*
  - *While Parts List BOMs may be included in an EPL, it is recommended to use EPLs in place of Parts List BOMs in most cases.*

Bill of Materials (BOMs) can be categorized to two unique types, the classic BOM that is attached to a virtual Inventory Item header that is then attached to the equipment or a PM Model, and Equipment Parts Lists that are attached directly to the equipment.

- ***Equipment Parts lists (EPLs)** - These parts should be the list of common replaceable items required for maintaining the asset and can be made up of single level with a list of Inventory items, or may include BOMs or Multi level BOMs. This should be considered the equipment specific list of parts from which parts can be assigned at time of planning. PM BOMs are not usually included in an EPL, since the parts contained in the BOM would usually be redundant to the list on the EPL. During WO Planning, parts may be selected from those attached to the EPL for the equipment number on the WO, and also from the EPLs connected to equipment that are children (in the equipment hierarchy) of the equipment number on the WO.*

Business Process – EPL and BOM Creation

Equipment Parts Lists (EPL's)

EPL creation consists of several steps:

- ***Assess which assets require an EPL. Base the order of priority for EPL creation on the criticality ranking of the assets. Every critical equipment must have a EPL. All other equipment should have one. These should be developed in order of priority based on the criticality ranking.***
- ***Determine what items should be on the BOM: In general, any spare parts or components for which there is a reasonable expectation of being repaired or replaced as a result of a preventive maintenance (PM) or repair maintenance work order should be included on the BOM. At a minimum, the BOM should reflect any item identified as a critical spare. In addition, the BOM should include any other materials used directly to repair the equipment, or any item for which it is necessary or beneficial to have usage history tied to the asset in the CMMS.***
  - ***Items that typically don't need to appear in the BOM include consumables and free-issue material, expense materials (rags, disposable overalls, etc.) and personal protective equipment.***

Determine what data should be on the EPL: Some of the EPL data will default from the fields available on the Inventory Item Branch record.

- ***For items with an inventory item number, the following elements should be considered the minimum required:***
  - ***Inventory Item Number***
  - ***Quantity***
- ***For items with no inventory item number, the following elements should be considered the minimum required:***
  - ***Inventory Item Number***
  - ***Quantity***
  - ***Description (properly formatted)***
  - ***Unit of measurement***
  - ***Manufacturer / Manufacturer's part number***
  - ***Preferred supplier / Supplier's part number***
  - ***Substitutes (whether allowed, and if so, manufacturer / Part Number)***

The data may come from a variety of sources, but the list of parts by equipment number is usually coordinated by a site Planner but may need assistance or approval by the Plant Engineer / Asset Specialists.

For brown field sites where OEM information cannot be found possible sources for the information include the Vendor, Tradesmen, Plant Engineer / Asset Specialist, and purchasing history. The most important thing is not where the data comes from, but whether it is accurate.

EPL Management

Several types of events can necessitate EPL modifications. Once an EPL is created, it must be updated as necessary and reviewed periodically to ensure its continued accuracy. For example, the same EPL may have originally been attached to several pieces of equipment, but over time, parts substitutions have been done, necessitating creation of separate EPLs for each equipment. Also, often the parts specifications may change (i.e. substitute a Viton O-ring for a Buna-N O-ring) which would require an EPL update.

Consider the following:

- ***Decommissioning***
- ***Design changes***
- ***Part substitution/standardization***

EPL review: The EPL is one of the principal tools used by the planner to properly plan work orders. As a result, the planner is the primary user of the EPL, and, therefore, is in the best position to monitor data accuracy. Periodic reviews should be done over time to assess the validity of these EPL's. In most cases, the planner will have the authority to document and make necessary corrections to the EPL's in the CMMS.

On the retirement of equipment, or during reviews of inventory spares requirements, the EPL "Where Used" inquiry should be used to identify on which equipment the spares under consideration are used.

Bills of Material (BOMs)

PM BOMs should always be created for Preventive Maintenance (PM) jobs, with Standard Labour Instructions and where appropriate, a list of Standard Parts for the job scope defined on the PM's Model WO.

Parts List BOMs should be created only in exceptional circumstances, where it is necessary to break an EPL down into groups of components and child equipment does not exist to which the EPL sub-component lists can be attached.

PM BOM creation consists of several steps:

- ***First, the virtual BOM Header record must be created.***
- ***Attach the PM BOM Header to the PM's Model WO.***
- ***Attach to the PM BOM header the standard Instructions and Standard Labour specific to the job scope identified on the Model WO.***

- *Items that typically don't need to appear in the PM BOM include consumables and free-issue material, expense materials (rags, disposable overalls, etc.) and personal protective equipment.*

Several types of events can necessitate BOM modifications. Once a BOM is created, it must be updated as necessary and reviewed periodically to ensure its continued accuracy. For example, the same PM BOM may have originally been attached to several Model WO's, but over time, parts substitutions have been done, necessitating creation of separate PM BOM's for each PM service. Also, often the parts specifications may change (i.e. substitute a Viton O-ring for a Buna-N O-ring) which would require an EPL update.

- ***Consider the following:***
  - ***Decommissioning***
  - ***Design changes***
  - ***Part substitution/standardization***
- ***PM BOM review: The PM BOM is one of the principal tools used by the planner to properly plan work orders with a recurring scope, principally PM WO's. As a result, the planner is the primary user of the PM BOML, and, therefore, is in the best position to monitor data accuracy. Periodic reviews should be done over time to assess the validity of these PM BOM's, and feedback from those executing the work will also be a source of required updates. In most cases, the planner will have the authority to document and make necessary corrections to the PM BOM's in the CMMS.***
- ***On the retirement of equipment, or during reviews of inventory spares requirements, the BOM "Where Used" report should be used to identify on which equipment and for which PM services the spares under consideration are used.***

BOM & EPL Metrics

- ***EPL completion: This is no more than a measure of whether an EPL exists in the CMMS for each functional equipment. The goal should be 100 percent for all critical equipment and 95 percent for others.***
- ***EPL accuracy: It usually reflects data captured during periodic reviews.***
- ***PM BOMs and Parts List BOMs are created in accordance with Naming Convention.***
- ***All PM's have a Model WO with an attached BOM Header, and the BOM contains at a minimum the Standard Labour Instructions (Labour Estimate) with the appropriate steps and durations for completing the defined job scope as defined on the Model WO.***
- ***Where appropriate, parts (stock and non-stock) are included on the PM BOMs in the Standard Parts Lists.***

BOM and EPL Benefits

The direct and indirect benefits of accurate EPLs and BOMs can be difficult to quantify, but aren't difficult to delineate.

- ***Fewer incorrect material purchases: By utilizing the information contained in the EPL or BOM to generate purchase requisitions, there is less of an opportunity for guesswork, variation or errors in the transmission of material requirement data to suppliers.***
- ***Faster execution of planned work: Accurate EPLs and BOMs reduce the amount of time spent researching required materials. This helps to streamline the planning and procurement processes, which in turn reduces the length of time required to obtain the necessary parts to complete the job. This allows faster execution of equipment PMs or CMs and gets equipment back on line sooner.***
- ***Faster execution of unplanned work: An effective EPL or BOM provides craftsmen with quick access to accurate part requirements and descriptions in an emergency situation. Combined with a reliable inventory control system, craftsmen can quickly determine the on-hand quantity and location of available parts in stock. Should insufficient inventory be available, the BOM or EPL can also provide valuable manufacturer and supplier details to facilitate expedited procurement.***
- ***Disposition of inactive inventory: Use EPLs or BOMs to determine whether a non-moving inventory item is required for an active asset.***
- ***More effective reliability engineering: Use EPLs or BOMs to identify similar items or equipment where individual materials can be standardized or substituted.***
- ***The CMMS will provide the capability to do an inverse examination of BOM data. Rather than querying an asset to see what parts are listed on the EPL or BOM, the system allows a query or report on a part and displays all the EPLs or BOMs where it is listed. This "where used" capability provides a tool for determining the impact of decommissioning and design changes on the continued need for specific material items.***
- ***Critical Spares analysis is facilitated by accurate EPLs and BOMs. Critical Spares are identified on the Inventory Branch record.***

SUMMARY

As a rule, the Asset Specialist or Plant Engineer is primarily responsible for providing initial BOM information and all engineering-driven changes. The planner is responsible for ensuring BOM accuracy. But the key to overall BOM effectiveness is to recognize that data creation and maintenance is a collaborative process that requires teamwork and communication.

BOM Naming Convention

This section applies to BOMs that are based on Inventory Item Master “Header” records, and does not apply to Equipment Parts Lists (EPLs – P13017)) that are directly linked to an asset record without using a “BOM Header” record.

Parts List BOMs

The BOM Naming Standard suggested for BOMs that are solely for Equipment Parts (and not for Preventive Maintenance jobs (PMs)) is as follows: BOMLOCDESCRIPTION, where the total number of characters in the alpha-numeric name does not exceed 26. Different Standards are allowable in different areas.

All BOM Inventory Item Masters for equipment parts list (not PM) BOMs start with "BOM". The "BOM" will be followed by the three digit Location Code from the Address Book Standards. No spaces, dashes, or other special characters shall be used in the first six characters. The remaining 20 characters should be used for a clear text description of the BOM.

The first six characters should also be the first nine characters of both the Description field and the Search Text field in the item master. Note: the search text field for BOMs is 30 characters and should clearly describe the equipment for which the bill of material was created.

PM BOMs

The BOM Naming Standard suggested for BOMs that are solely for Preventive Maintenance jobs (PMs) is as follows: PMBOMLOCDESCRIPTION, where the total number of characters in the alpha-numeric name does not exceed 26. Different Standards are allowable in different areas.

All BOM Inventory Item Masters PM BOMs start with "PMBOM". The "PMBOM" will be followed by the three digit Location Code (refer to the Appendix in the Equipment Procedure). If the PM BOM is common to multiple sites, then use some agreed generic designator (i.e. like “TRO” or “TRON”) or use a higher level area designator (i.e. “BDE” for work managed out of BDE). No spaces, dashes, or other special characters shall be used in the first eight characters. The remaining 18 characters may be used for a clear text description of the PM for which the BOM is created. It has been found useful to identify in the PM BOM number the Model Work Order Number to which the PM BOM is to be attached, since this clearly cross references that PM Master file and the Inventory Master file.

The first six characters should also be the first characters of both the Description field and the Search Text field in the item master. Note: the search text field for BOMs is 30 characters and should clearly describe the equipment for which the bill of material was created.

Approvals

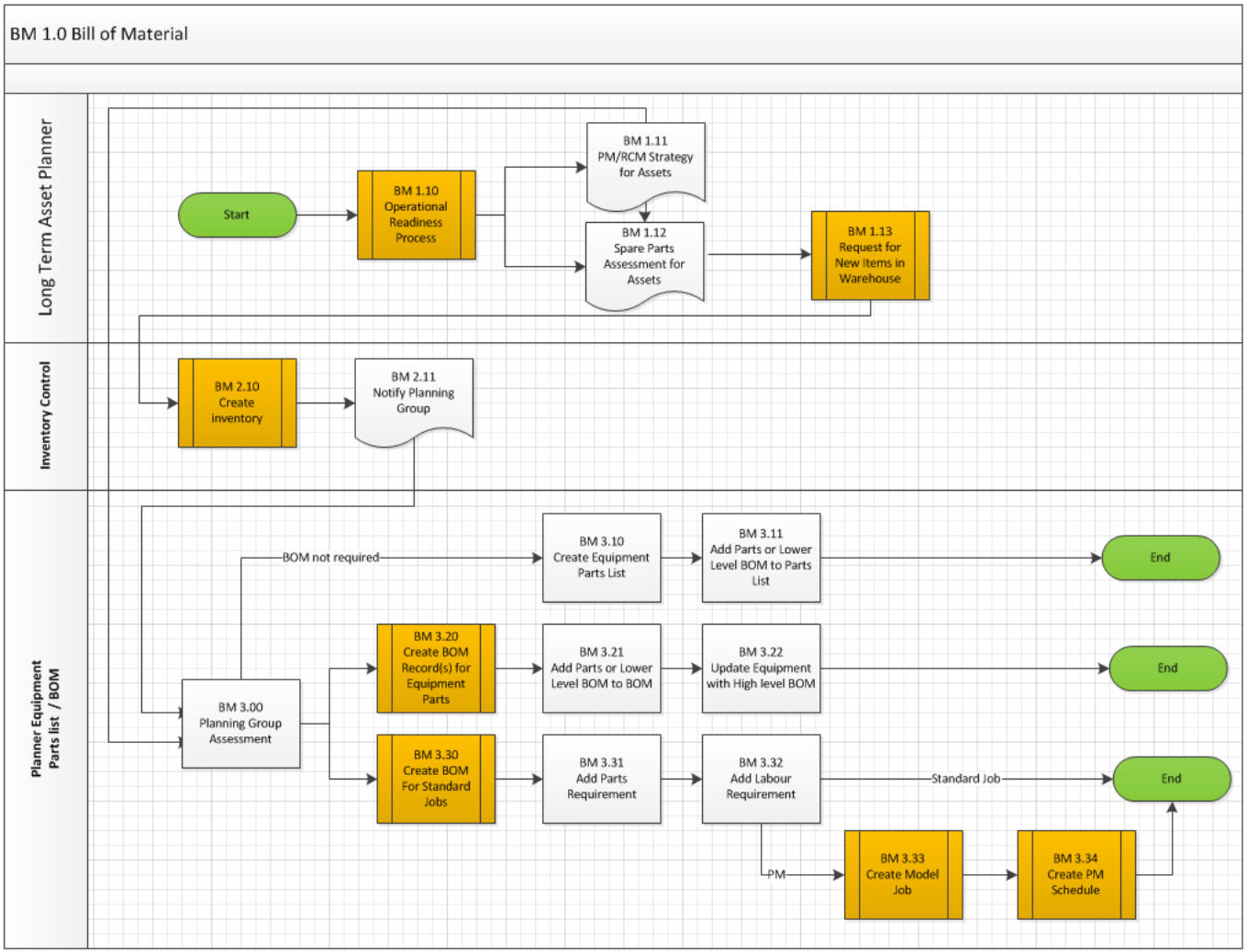
	(name)	(signature)	(yyyy/mm/dd)
	(name)	(signature)	(yyyy/mm/dd)

Appendix I – Definitions and Business Rules

<< Add any agree upon business rules or definition associated to the business processes.>>

Business Process

Scheduling -The following sample business process provides only the first level of detail Information on the groups or individual positions, their associated tasks (steps) in the process and high level descriptions for each step.



Role	Step ID	Step Title	Step Description
Long Term Asset Planner	BM 1.10	Operational Readiness Process	Proceed to – Operational Readiness Process
	BM 1.11	PM/RCM Strategy for Assets	During your design process – identify PM requirements as well as Standard Job requirements that may not be triggered by a "time" or "meter" based even. Forward all Equipment Parts list requirements, PM, Standard Jobs and OEM Repair Manuals/Requirements to local Planning Group.
	BM 1.12	Spare Parts Assessment for Assets	Both the PM/RCM strategy and the Manufactures parts recommendations are required for this assessment. It is from this assessment that the Asset Specialists will assess the requirement for additional inventory parts to be assigned to their warehouses. This should include a yearly consumption assessment, required hold quantity, and if these parts are required to be stocked or be an order on request part.
	BM 1.13	Request for Inventory	Follow standard Nalcor "Request for Inventory" policies.
Inventory Control	BM 2.10	Create Inventory	Follow standard Nalcor "Create Inventory" Process
	BM 2.11	Notify Planner Group	Once the appropriate parts have be created in local warehouse forward the completed warehouse request to the Local Planning Group.
Planners	BM 3.00	Planning Group Assessment	Local Planning Department will receive appropriate documentation from Asset Specialists and assess the requirements for: • Equipment parts lists • Equipment BOM's • BOM for Standard Jobs and PM requirements. Many CMMS systems have many ways of tracking Equipment Parts list, some require a BOM created that is attached to the Asset, and others are directly attached to the asset. Equipment parts list are the Equipment's "shopping list", Equipment parts lists or BOM's, do not hold Labour requirements. This is the first building block for the Planner, and should be a primary focus when designing your system. It is important to assess the tractability or traceability that either way will may give you.

Role	Step ID	Step Title	Step Description
			PM and Standard Job requirements, will have both the appropriate Labour requirements as well as Parts requirements and standard "PM Procedures" should be followed. Standard Jobs can be taken down only to the BOM level but may have association with standard PM Job that would require a Model Work Order Created. While PM requirements need the creation of Model work. ***Policy should be considered for the management of Standard non Metered or Timed event should be used.***
Planners – Equipment Parts List	BM 3.10	Create Equipment Parts List (no BOM required)	Call up your equipment parts program; attach required parts and quantities to equipment record.
	BM 3.11	Add Inventory or Lower level BOM to Parts list	From the requirement gathering – add the following • Inventory Requirement – add part and quantity • Kit or Component level BOM – Component level BOM can be created to reflect major components. These component level BOM's usually are established where common components common through multiple units. Component level kits normally are named or numbered to reflect a Manufacturing spec for this component. • Non Catalogued parts – these are parts that do not have a company Inventory Item number. Normally if parts are identified for a Parts list it will be reordered it should be identified in your Warehouse list. ** Policy should be defined. ***You will need to know how your system will hold nonstock parts, and order on request parts, and non-catalogued parts (some systems do not require a Company Part number and a policy should be written on how to handle these).***
	BM 3.20	Create BOM for Equipment Parts	Follow current "BOM Creation Procedure" ***BOM for Equipment Parts list normally will be made as a one to one to the equipment***

Role	Step ID	Step Title	Step Description
Planner – Equipment BOM			***and reflect the same Unit number identifier. Company Policies should be created for this.*** `
	BM 3.21	Add Parts	Equipment BOM need to be created for the Branch Plant or Warehouse in which you source your materials and can have the following attached. • Inventory Requirement – add part and quantity • Kit or Component level BOM – Component level BOM can be created to reflect major components. These component level BOM's usually are established where common components common through multiple units. Component level kits normally are named or numbered to reflect a Manufacturing spec for this component. Normally these BOM's will copy or can be copied to the Corrective work orders – it is at this time the planner will have the visibility of what is held in this BOM, and determine if they would like to change the work order to the lower level kit. It should be noted that these BOM without a break levels for a high level equipment can get large and unmanageable. ***Equipment BOM do not hold labour instructions just the Parts Requirements.***
	BM 3.22	Update Equipment Record	Once the parts list or BOM is completed – Update Equipment record with BOM number and Save.
Planner Standard Job BOM	BM 3.30	Create BOM for Standard Job / PM	Follow current "BOM Creation Procedure" ***BOM for Standard Job / PM, normally have the service type or Model work order number Identified in the Numbering convention. Company Policies should be created for this*** Considerations for Standard Job BOM: BOM's for Standard Job can just be left at the BOM level if desired without creating a Model Work Order, and this can be used for when managing the work order. The BOM

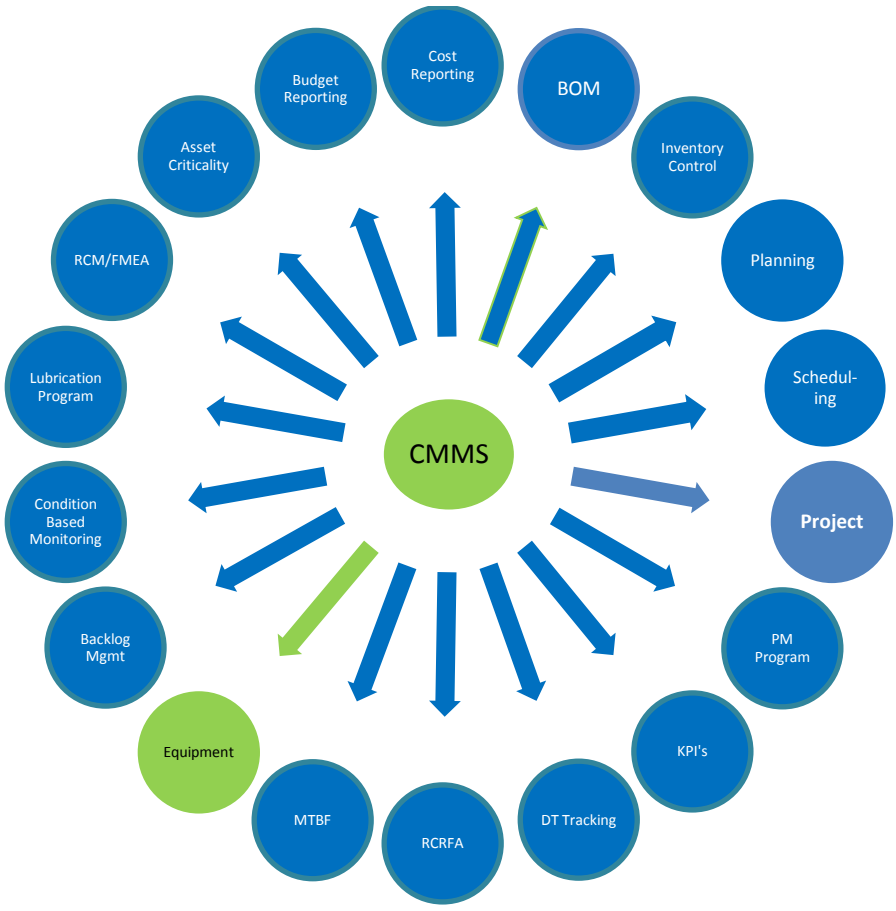
Role	Step ID	Step Title	Step Description
			can hold both the Parts and Labour requirements for this Task driven BOM, but recommending taking these events to Model Jobs. The missing in leaving it at the BOM level is that in most cases it is hard to find as well as not having the ability to fully describe the Task and Procedures for the completion of the job. These Models would be set up in the PM system without a Meter or time event that allows the generation of these jobs to be Conditional. ***Consideration for PM BOM*** ***In many cases these BOM are used incorrectly and hold to many parts or labour requirements, theses should not be used as catch alls. The PM BOM and its set up is the bases for parts commitment, and Forecasting. PM should be a specific set of task and with agreed upon parts requirement.***
	BM 3.31	Add Parts Requirement	Add parts requirements
	BM 3.32	Add Labour Requirement	Add Labour requirements ***If you are only creating BOM for Standard Parts the process ends here.***
	BM 3.33	Create Model Job	Use Nalcor “Model Work Order Creation”
	BM 3.34	Create PM Schedule	Use Nalcor “Creating a PM Schedule

Corporate Business System - ERP Assessment

Business Process Document

Create and Manage Equipment Records

December/2016



Version	Date	Description of Revision	Author
	2016-12-20	Updated after process review	S. McCarthy

Contents

Purpose

The Manage Equipment Process covers several sub-processes, including:

- Setting up Functional Equipment Groups
- Creating Equipment and Fixed Asset Records
- Creating New Equipment from a Capital Project
- Setting up Equipment Hierarchies (Parent-Child Relationships)
- Defining Asset Criticality
- Changing Equipment Details
- Swapping out Rotable Equipment
- Transferring Equipment locations and Business Units
- Retiring / Disposing of Equipment

Background

Asset Hierarchy

In 2011, an effort was in progress to create standard asset hierarchies. "*The hierarchy is the actual decomposition or disaggregation of plants, facilities, lines, etc. into increasingly smaller systems and elements until a level is reached that meets both financial and maintenance needs. The registry of each asset in this hierarchy represents the one to one file containing all required asset information to support financial and maintenance needs. The application of prioritized condition assessments on these assets based on criticality and preliminary condition assessments are key inputs to a robust long term asset management plan.*" Standard Hierarchies by system are shown in Appendix 3.

Functional Equipment Groups (FEGs)

A Functional Equipment (FE) is a group of equipment components that in their operating context perform or support a defined function. The boundary of the FE is drawn based on the border of the function. The FE process also supports consistent determination of equipment criticality. Maintenance groups think of equipment in terms of the ability to maintain a "function". For example, the function of a pump may be "to move water at up to 70^{o}F from the sump to a storage tank at a rate of 30 USGPM, in the presence of a spare installed pump with automatic transfer". The FE would include the power supply, local controls, the motor, coupling, and pump.

While a Functional Equipment represents a specific group of assets or components, a FEG is a high level categorization of FE's by physical characteristics or design (i.e. Pumps, Heat Exchanger, Distribution Line). In the JD Edwards EnterpriseOne (JDE E1) software, the available selections of Failure Analysis Codes are specific to the FEG codes assigned to the equipment record. The FEG code is assigned in the fields called "Product Model" and "Product Family", which respectively are "Equipment Sub-Type" and "Equipment Type".

Functional Equipment is therefore usually equipment against which Work Orders are desired. Whether Work Orders are possible depends on two criteria:

- The asset record must also have an "Equipment" record (i.e. Both an F1201 and a F1217 record).
- The asset record must be coded to allow Work Orders (i.e. F1201:WOYN = Y).

How to code the equipment for Type and sub-type (i.e. Product Family and Product Model) and how to code the WOYN (i/e/ Work Order Allowed) field are shown in Appendix 3.

Equipment Master Records in JD Edwards EnterpriseOne (JDE E1)

The terms, "Asset". "Fixed Asset", and "Equipment" are often used interchangeably. The distinction, going forward, will be as follows:

- A Fixed Asset currently represents a depreciable asset created through a project.
- An Asset may or may not be a depreciable asset. Many asset records are created in JDE E1 to represent higher level "system" equipment needed to build the asset hierarchy. Many asset records are created for lower level equipment used to define the equipment but which may or may not be used on Work Orders.
- A Equipment record is an asset for which it is desired to create work orders. Functional Equipment is defined previously. If it is desired to create Work Orders for an equipment, then the equipment must have an FEG code (i.e. Equipment Type (Product Family) and Equipment Sub-Type (Product Model)).

A single functional equipment may be represented by many fixed assets, or vice versa. The rationale for having both Fixed Assets and Functional Equipment in the same asset hierarchy is that this makes it easier to keep fixed asset records in line with the facts on the ground.

In JDE E1 software, the FEG codes establish a hierarchy that supports several processes, including some that are not currently performed:

- Failure Analysis by Equipment Type – supported by JD Edwards E1 software's Failure Analysis functionality.
- Cost Analysis by Equipment Type – supported by JD Edwards E1 software's Equipment Cost Analysis (ECA) functionality.

Asset Criticality

In 2011, a Nalcor Criticality Assessment standard was published, requiring that "*the line of business plant/facility(s) rates their own maintainable equipment/assets in order of importance to the business*". The Asset Criticality assessment at the time was supported by a process led by a consulting company and resulted in the analysis results being captured on spreadsheets. The results have not been entered on the equipment records. The focus of the Asset Criticality effort was toward Long Term Asset Planning; discussions with plant and area personnel have revealed that this is still the common belief.

Asset Criticality is a useful benchmark for various metrics, given that the efforts of maintenance program analysis and improvement should focus primarily on the most critical assets. The asset criticality ranking should be included as a category code on the equipment record, but should not be carried across to the work order, nor should the asset criticality be used in work order prioritization.

Control of Equipment Records

Equipment records consist of a number of fields, in which both field values and the options available are the responsibility of various groups, including Fixed Assets, Cost of Service, and of course Asset Owners.

In JDE E1 software there is scope to allow multiple groups control of elements of the asset and equipment records or parts thereof through security. That is, JDE E1 security will allow Maintenance to change "Maintenance only" codes and fields, while protecting those fields of importance to Fixed Assets. As well, in JDE E1 software the "fixed asset only" records can be inhibited so that users can be prevented from creating work orders against them.

Equipment Locations

In JDE World software and for Fixed Assets in JD Edwards E1 software, the equipment location is tracked using a Location Code, which is actually a Business Unit (BU) type "LC". In JD Edwards E1 software the BU location is not much used for Equipment, but is still used by Fixed Assets. The Location tracking functionality has been supplemented for JDE E1 Equipment records through the use of Address Book Locations, which have repurposed existing Address Book fields in the Asset Master as "Location" fields called "Customer" and "Site" (F1201:LANO & F1201:AN8). Full history tracking is turned on for the Address Book locations, same as for BU Locations.

Typically, Address Book Locations are defined down to the system or sub-system level within a cost "Responsible BU", which provides a handy way to search for and summarize equipment history and cost.

Equipment Description Convention

This section does not apply to financial fixed assets that are created for Finance purposes only.

The name or description for functional equipment should follow the Noun, Modifier Format. Noun denotes the equipment type while the modifier denotes the service of the equipment. There are three (3) equipment description fields in E1.

A functional equipment such as a boiler feed pump, for example, may contain multiple components such as motors and control valves. The main item of equipment is the pump itself, so while the Description 1 field will identify the whole Functional Equipment assembly, the Description 2 field will provide pump information.

1. **Asset Description (Description 1)**: NOUN SERVICE LOCATION, e.g. PUMP BOILER FEED 3W
2. **Description 2**: MANUFACTURER MODEL e.g. BINGHAM 8 X 10 MULTISTAGE
3. **Description 3**: Operations' Equipment Name or how the equipment is called by the operators e.g. FEED PUMP 3 WEST

F1201

Element	Description	Type	Length
DL01	**Description**	Alpha Numeric	30
DL02	**Description 02**	Alpha Numeric	30
DL03	**Description 03**	Alpha Numeric	30

Equipment descriptions shall be entered in Upper Case letters with no special characters or punctuation. Spaces are allowed. Commas and Asterisks are forbidden.

Equipment Numbering Convention

This section does not apply to financial fixed assets that are created for Finance purposes only. This is because a "Finance only" asset record may only be assigned an Asset Number and neither a Unit Number nor a Serial Number.

There are three (3) equipment number fields in E1.

1. Asset Number: In JDE E1 software, this is the primary asset designator and it will always be the number used by the JDE E1 software as the unique key field for locating records.
2. Unit Number: The Unit Number is optional. If Unit numbers are input, since there is a technical requirement for the values in this field to be unique, then the Unit Number should be given a prefix location code (using the standard location abbreviation list in Appendix 4).
3. Equipment Number: The Equipment Number will be the primary equipment designator for functional equipment. As such, it will appear in all screens instead of the Asset Number. Where no Equipment Number is assigned manually, the Asset Number is used by default. The standard is to input in this field the equipment number as identified on the process flow diagrams, or the number that is commonly used by Maintainers and Operators to identify the equipment (e.g. HRDBFP3W). Since there is a requirement for the values in this field to be unique within Product Model / Product Family (PM-PF) combinations, then where there may be duplicates the Equipment Number should be prefixed by a location code (using the standard location abbreviation list in Appendix 4). An example exception to using the standard location designations for the prefix is Transmission lines, where the Line Number (i.e. TL236) meets the need.

Equipment Numbers shall be entered in Upper Case with no special characters or punctuation. Spaces are discouraged.

F1201

Element	Description	Type	Length
NUMB	Asset Number	Signed Numeric	8
APID	Unit Number	Alpha Numeric	12

ASID	Equipment Number	Alpha Numeric	25

Since when equipment is disposed or relocated the function of the equipment remains, equipment that replaces the moved or disposed equipment shall have the same Equipment Number applied as was used on the previous equipment. The Equipment Number field needs to be cleared or changed on the previously installed equipment.

Should it be desired to record the Manufacturer's Serial Number, and since Manufacturer's Serial Numbers are not unique across all Manufacturers, the new Serial Number field (F1201:KITL) field on the equipment master will be used. This is a 25 character field that will accept manual input.

Equipment Disposal or Replacement

Equipment that has been retired or removed from service must be identified as disposed in the equipment database so that no further charges will accrue to those equipment records. This activity is undertaken whenever an asset is retired or removed from service.

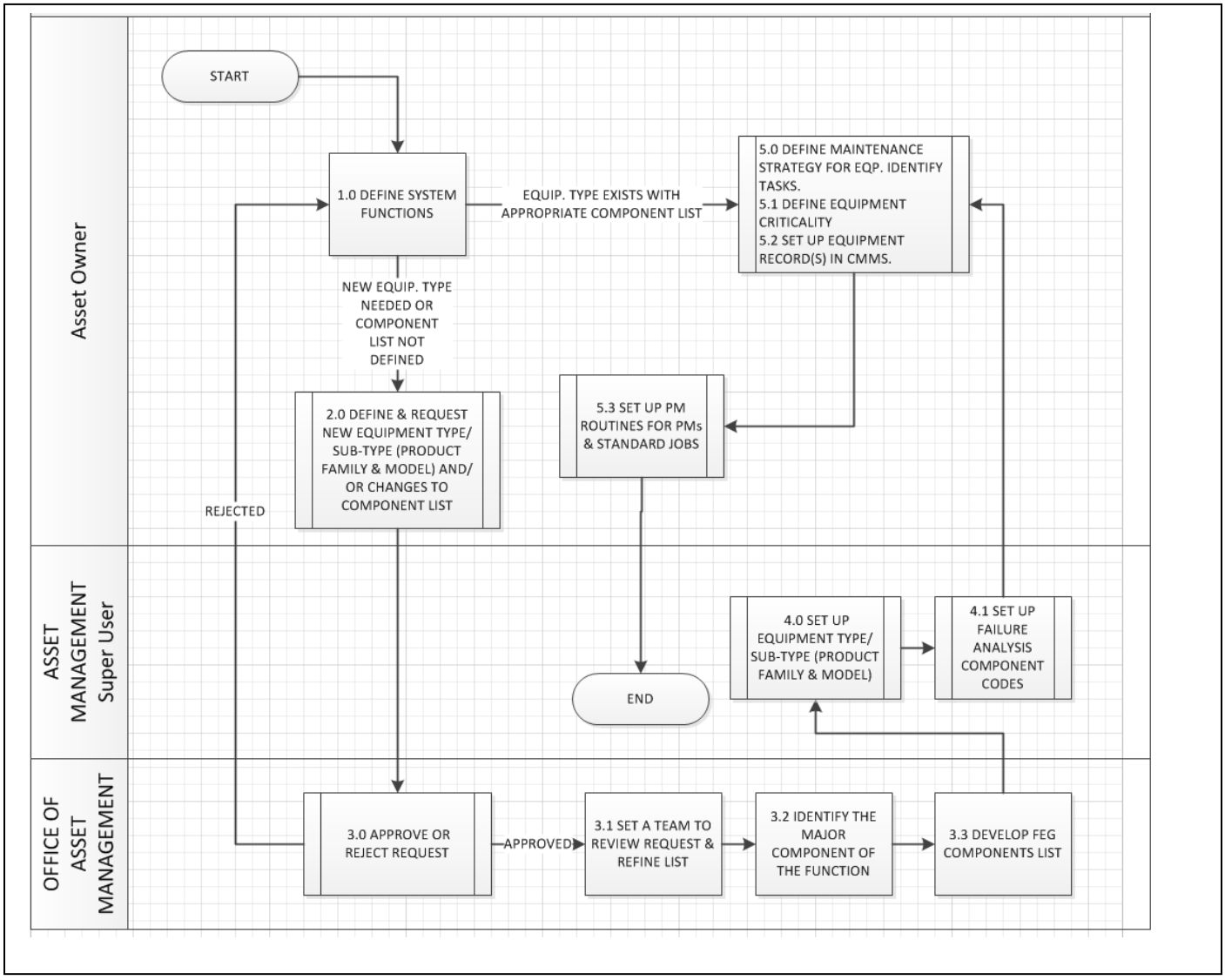
As part of disposing or replacing an asset there are various activities which need to be performed. An asset registered in E1 which has been physically retired and/or disposed of, must be marked in the asset database so that no further charges will be accrued to that asset record.

It is rare that the functional equipment record itself is being retired, since the functional equipment does not usually coincide with a depreciable asset record. If the asset being retired is also an equipment, then Work Orders, Inventory parts and PM Services associated with the equipment must also be removed or re-directed.

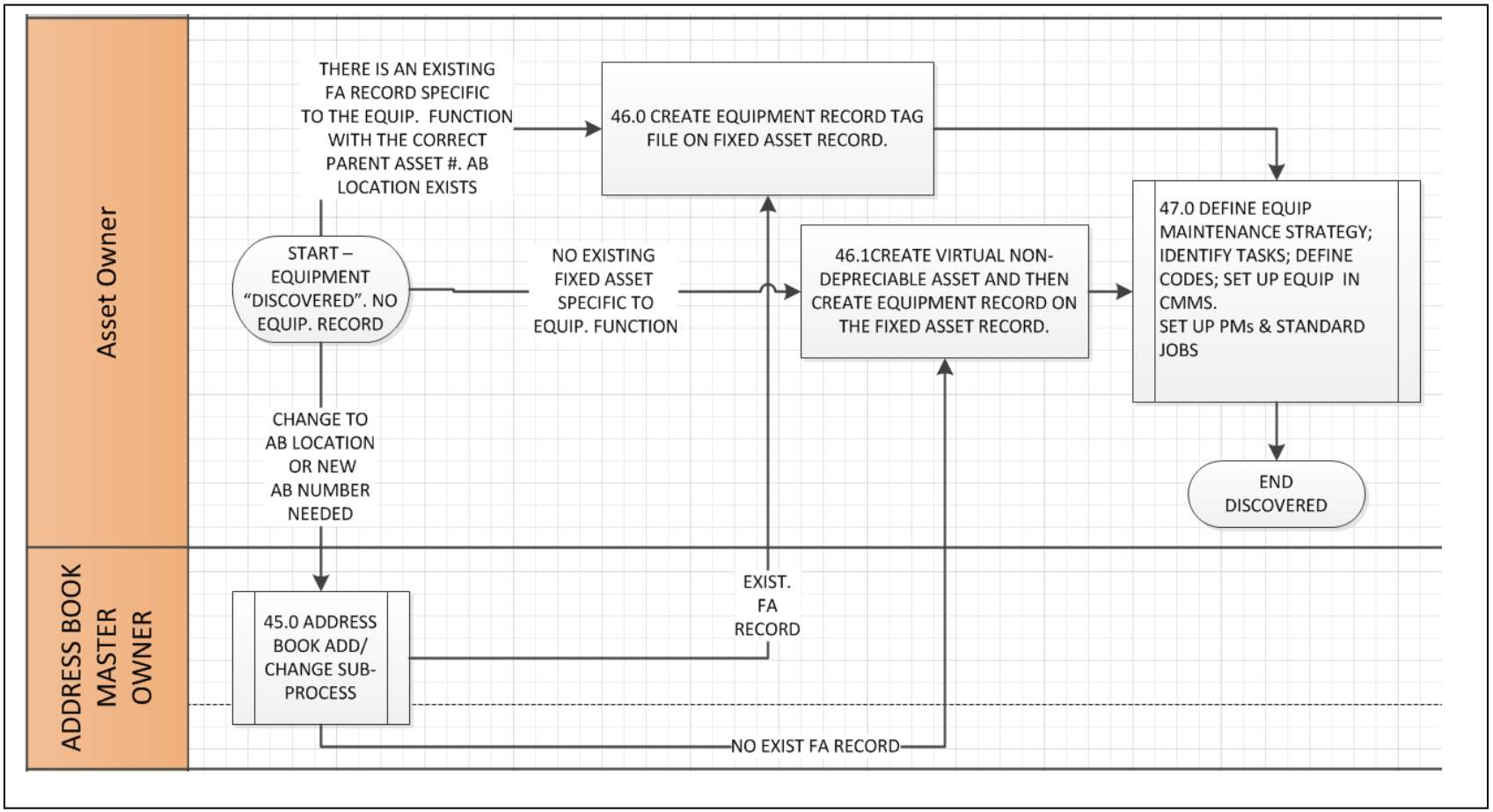
- Equipment
    - Change the description and Equipment Status
    - Check if equipment being disposed has any children in the hierarchical structure. If any exist, remove or relocate child equipment.
    - Supplemental or Specification Data may need to be entered for the replacement asset.
- Work Orders
    - Check if there are any outstanding work orders for the Equipment which is to be disposed. If some exist, evaluate need to complete or cancel.
- PM Services
    - Check if any PM Service types are registered against the equipment. If any exist, delete. Set the PM Services up against the replacement equipment if appropriate.
- Inventory Items
    - Check to find out if any inventory items are stocked solely for this equipment or if the number of equipments or services that use the parts is reduced, consider analysis of stock holdings for inventory reduction.
    - Delete equipment BOM components (F3002) and/or equipment parts list components.

Business Processes

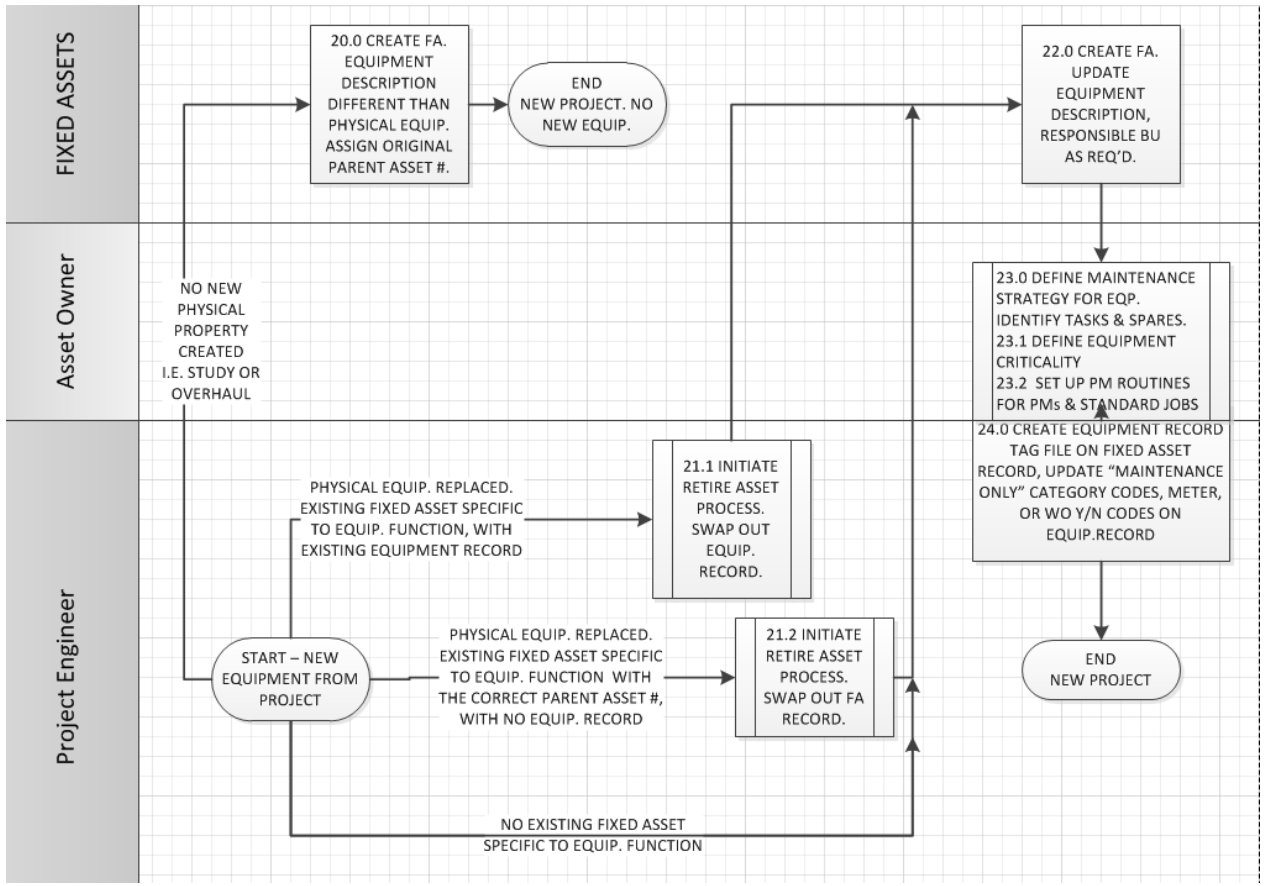
Setting up Functional Equipment Groups and Failure Component Codes



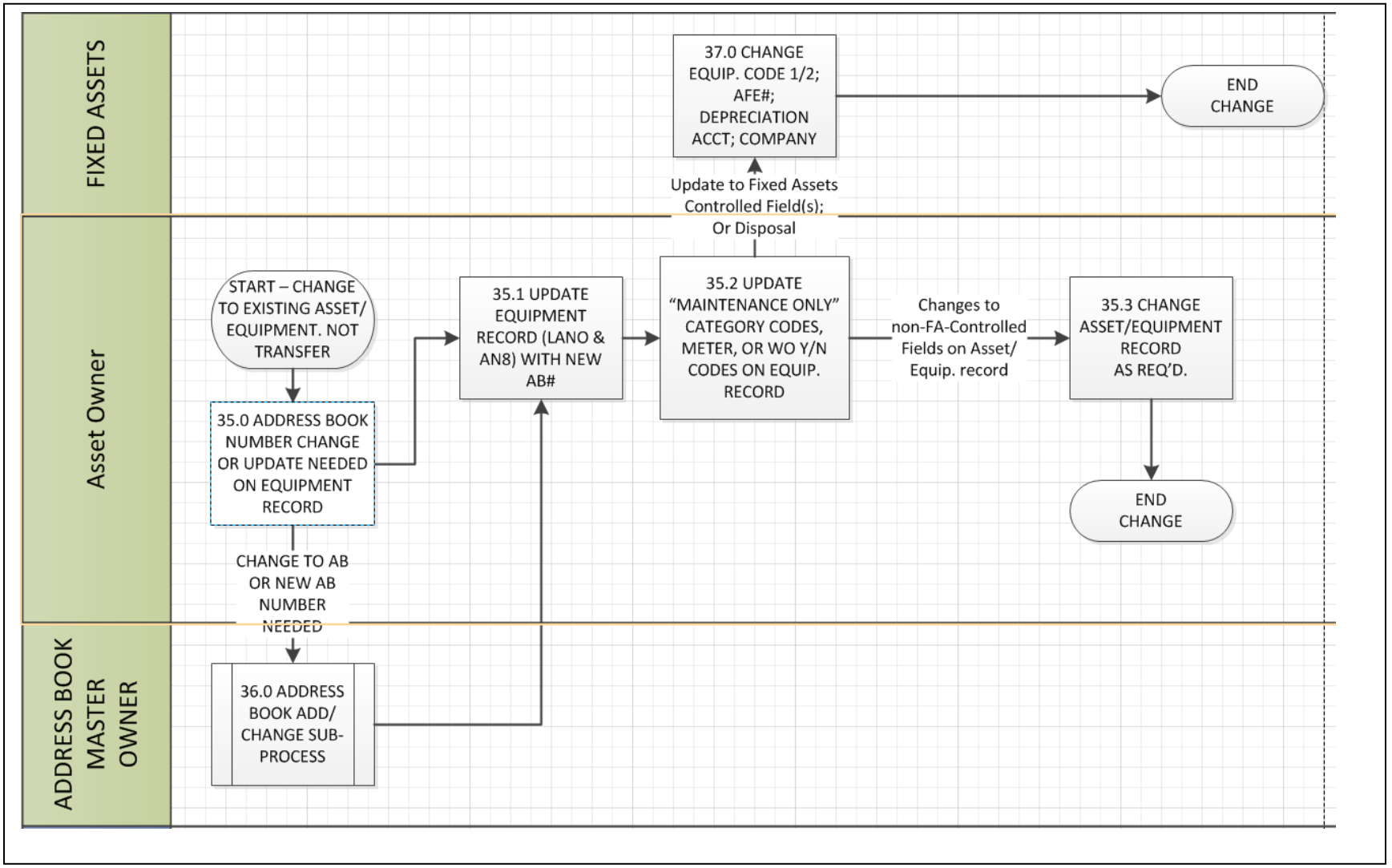
Creating New Combined Equipment and Fixed Asset Records



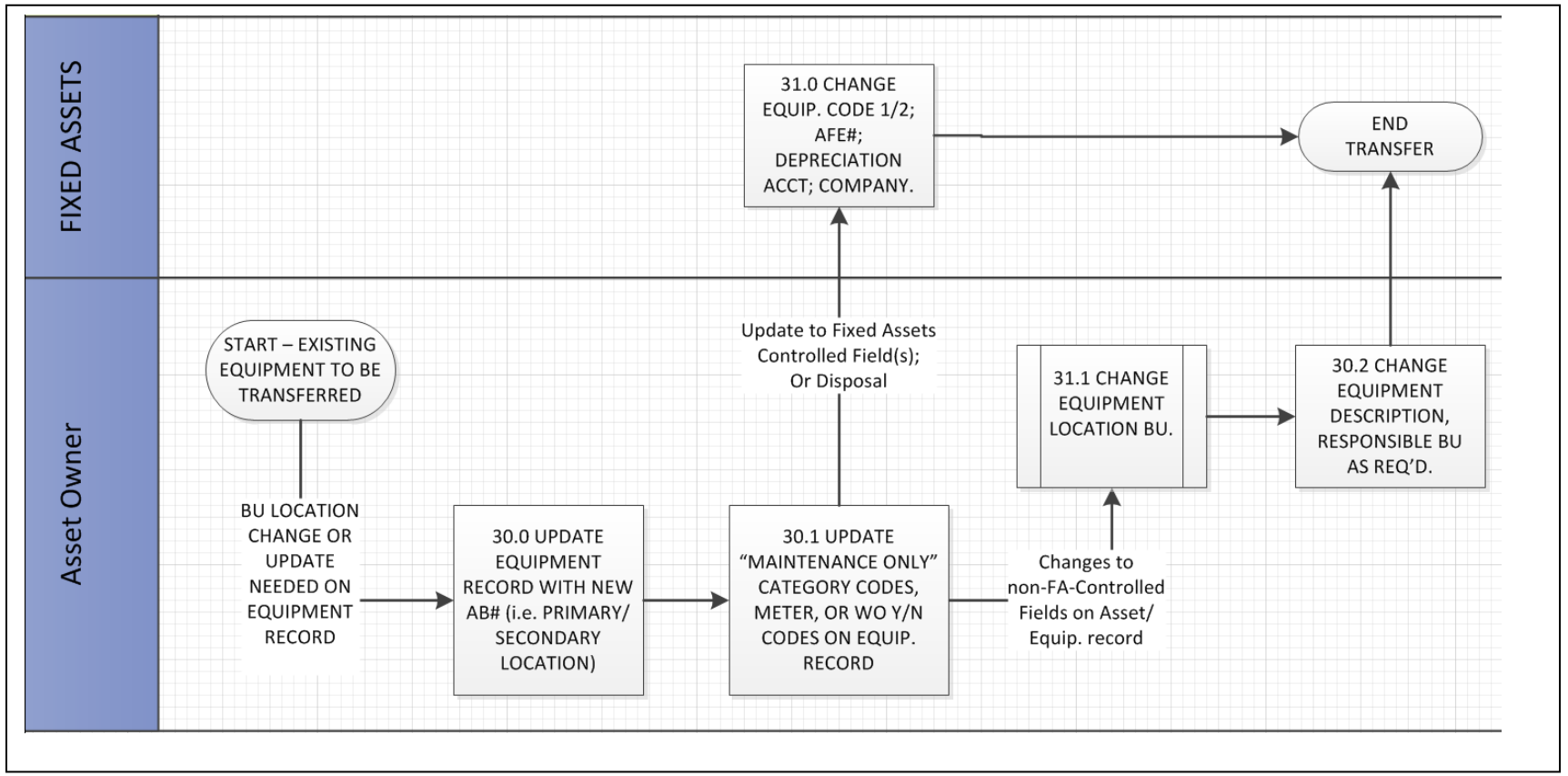
Creating New Equipment from a Capital Project



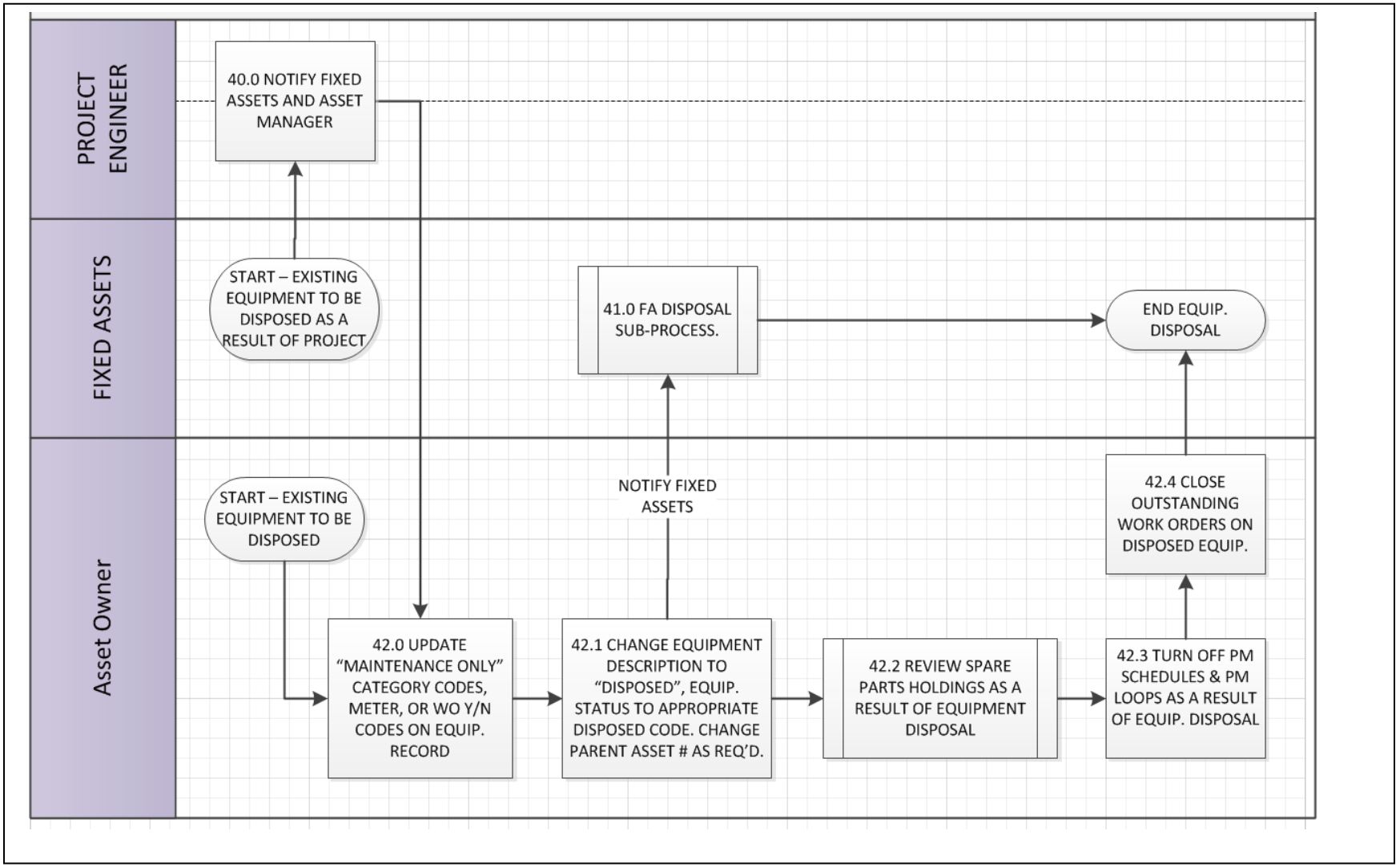
Changing Equipment Details



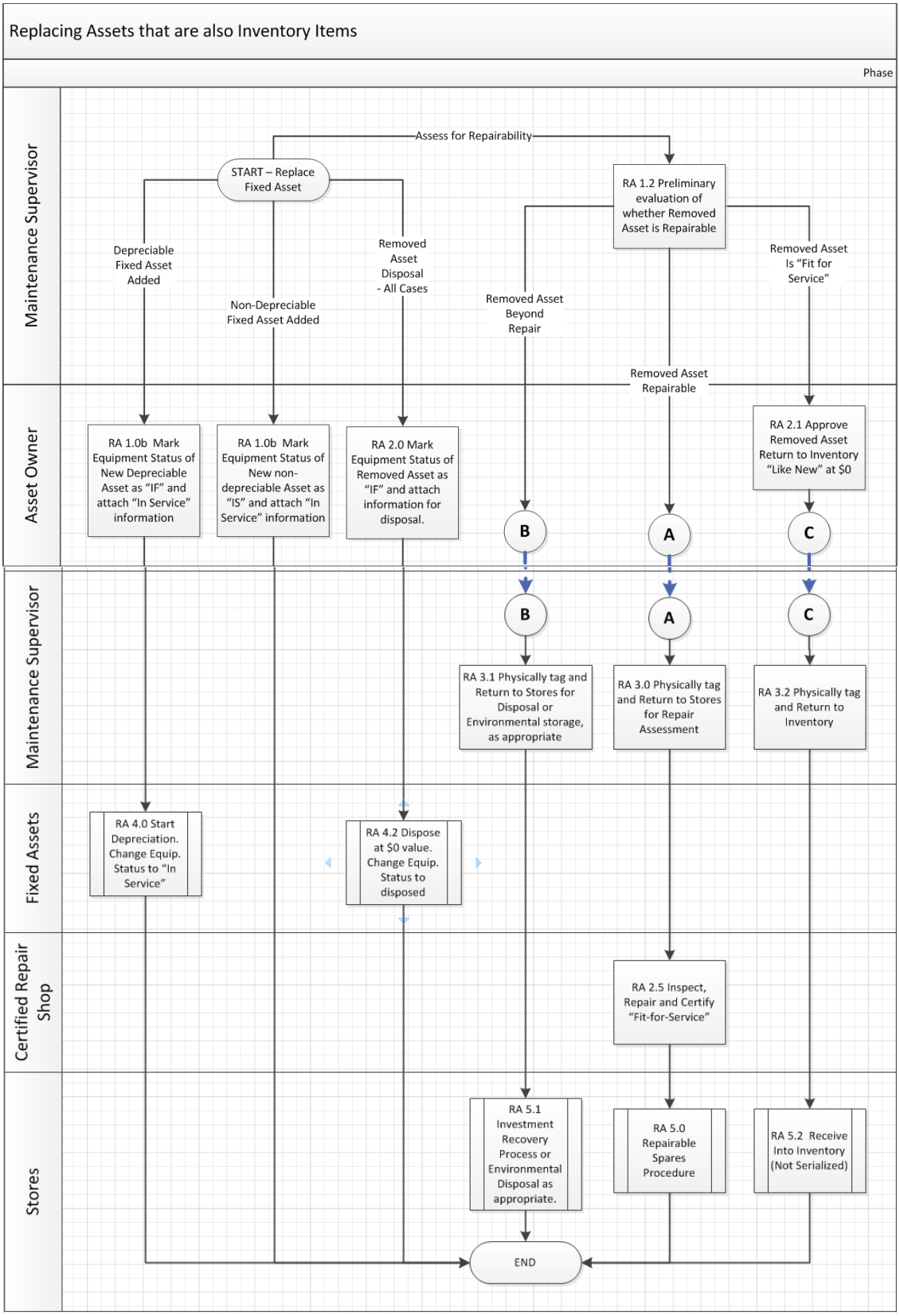
Transferring Equipment locations and Business Units



Retiring / Disposing of Equipment



Replacing Assets that are Also Inventory Items



Metrics for Create & Manage Equipment Records Processes

- Number of Criticality Assessments Completed
    - Number of equipment records, including neither records that are solely Financial fixed assets nor disposed equipment, for which a criticality assessment has been completed, the result entered as a category code on the equipment record, and the assessment worksheet attached to the equipment record.
- Active Equipment Count
    - Total count of equipment records, including neither records that are solely Financial fixed assets nor disposed equipment, that require a criticality assessment.
- Critical Equipment Count
    - Total count of equipment records, including neither records that are solely Financial fixed assets nor disposed equipment, that are identified as Most Critical.
    - Identify Critical Assets from the Criticality Worksheets and ensure that the equipment has the appropriate criticality ranking on the Equipment Master.
- Number of Equipment Parts Lists created
    - Total count of Most Critical equipment, including neither records that are solely Financial fixed assets nor disposed equipment, that have an Equipment Parts List (EPL) created containing more than one SKU (i.e. Item Master exists).
- Failure Analysis Tree Health
    - Number of Repair Work Orders completed during the month that have Component Code identified as “Other”.
    - Number of Repair Work Orders completed during the month that do not have entries in each of the failure codes, or do not have a bottom level code specified.
- Number of improperly disposed equipment records
    - Equipment records that have the words “disposed” or “do not use” in the description fields, but are not at an equipment status used for a disposed code.
    - Disposed equipment records that do not have the description changed.
- Local procedure in place in agreement with Nalcor process and in standard format, with responsibilities assigned to positions. A RACI (Responsible, Accountable, Consulted, Informed) diagram is an example of an appropriate approach.
    - Local procedure is published and there is awareness of the procedure and its contents among the affected personnel and positions.
- BOMs that contain parts and are linked to disposed equipment or no equipment.
    - In support of inventory analysis, measures whether spare parts are disconnected from BOMs once the equipment is disposed. The “Where Used” report for BOMs identifies the BOM on which the part is used, and not the equipment on which the BOM is used. This measures whether Parts List BOMs are being cleared when equipment is disposed.
        - PM BOMs are excluded.

  - This is not an issue for Equipment Parts Lists (EPL) since unlike the “BOM Where Used” report the Equipment is referenced directly on the “EPL Where Used” inquiry, with a description.
- Confirm that the lowest usual level of equipment for which work orders are allowed corresponds to the defined “Functional Equipment Groups” (FEGs). The process and system design is based on creating equipment records against which work orders may be created only at the “functional equipment” level, and not at the component level.

Approvals

	(name)	(signature)	(yyyy/mm/dd)
	(name)	(signature)	(yyyy/mm/dd)

Role	Step ID	Step Title	Step Description
Process			**Functional Equipment Group (FEG) Definition**
Long Term Asset Planning	1.0	DEFINE SYSTEM FUNCTIONS	The equipment function is the equipment type. Where Work Orders are permitted against the equipment, the equipment type shall be a type defined in the equipment type/sub-type codes (i.e. Product Family and Model). This assignment will drive analysis by equipment type and provide a equipment type specific tree of failure analysis codes to be applied to Repair Work Orders.
	2.0	DEFINE & REQUEST NEW EQUIPMENT TYPE/SUB-TYPE (PRODUCT FAMILY & MODEL) AND/OR CHANGES TO COMPONENT LIST	If the needed Product Family and Model code combination does not exist, then an application must be made to the Office of Asset Management for a new set of codes, and newly defined failure analysis code trees specific to the equipment type.

Role	Step ID	Step Title	Step Description
Process			**Functional Equipment Group (FEG) Definition**
OFFICE OF ASSET MANAGEMENT	3.0	APPROVE OR REJECT REQUEST	The Office of asset Management is the Owner of the Maintenance Business Processes, and has the responsibility to maintain conformity of use of the CMMS across Nalcor. The IT group is not responsible for approving the content of the codes, but the IT Asset Management BA should be consulted to ensure that integration points and arcane details of software functionality are considered.
	3.1	SET A TEAM TO REVIEW REQUEST & REFINE LIST	The Office of asset Management may wish to form an ad-hoc committee of knowledge experts to review the proposed additions and changes to the Product Family and Model code combinations and develop the associated failure analysis codes, including the component list.
	3.2	IDENTIFY THE MAJOR COMPONENT OF THE FUNCTION	The Major Component is the newly proposed Product Model, i.e. “Pump Centrifugal Electric Motor drive”
	3.3	DEVELOP FEG COMPONENTS LIST	The Components List is the tree of components and sub-components of the defined Product Model, including all of the parts of the functional equipment group. For the electric motor driven centrifugal pump, this would include the power supply, local controls, valves, instrumentation, switches, the motor, coupling, and the pump itself. There also may be a gear-box or a VSD.

Role	Step ID	Step Title	Step Description
Process			**Functional Equipment Group (FEG) Definition**
ASSET MANAGEMENT BA (IT)	4.0	SET UP EQUIPMENT TYPE/SUB-TYPE (PRODUCT FAMILY & MODEL)	The Product Model and Family Code should be set up in the CMMS and linked to the Failure Analysis Code trees, so that the Failure Analysis codes specific to the defined Product Family/Model codes may be available when a Repair work order against that equipment is being processed.
	4.1	SET UP FAILURE ANALYSIS COMPONENT CODES	When approved, the Failure Analysis Codes should be set up in the CMMS.
Long Term Asset Planning	5.0 – 5.3	Continue with the equipment set-up.	Regardless of whether the equipment is shared with Fixed Assets, the maintenance strategy, equipment criticality, and PM routines and spare parts must be set up in the CMMS. Codes like the Product Family and Model are “Maintenance-Only” codes that can be updated without a need to get approval from Fixed Assets.

Role	Step ID	Step Title	Step Description
Process			**Creating New Equipment from a Capital Project**
Fixed Assets	20.0	CREATE FIXED ASSET (FA). EQUIPMENT DESCRIPTION DIFFERENT THAN PHYSICAL EQUIP. ASSIGN ORIGINAL PARENT ASSET #.	If there is no new physical property created as a result of a capital project, for instance when a maintenance overhaul is capitalized, or a study done, then there is no need for Maintenance to see or have created an Equipment record. A Fixed Asset record may be created for the project if the cost is not going to be rolled into the existing asset (as at Q1 2015 it appears to be the practice to create separate fixed assets for all new work.) The asset's WO Allowed field (F1201:WOYN) should be set to NOT allow Work Orders.
	22.0	CREATE FA. UPDATE EQUIPMENT DESCRIPTION, RESPONSIBLE BU AS REQ'D.	In the event that a fixed asset is replaced or a new fixed asset and unit of physical maintainable property is created, then one or many fixed asset records should be created, but only if the fixed asset record and the physical equipment record are to share the same F1201 Asset record (i.e. Poles have separate fixed asset and equipment (structure) records.) As well, if the fixed asset record and the physical equipment record are to share the same F1201 Asset record the Fixed Asset record must be created in accordance with the standard equipment hierarchies defined by the Office of Asset Management, and defined in accordance with the approved list of Equipment codes for Equipment type and sub-type, Product Model and Family.
Long Term Asset Planning --and— Project Engineer	23.0 23.1 23.2	DEFINE MTCE. STRATEGY FOR EQP. IDENTIFY TASKS & SPARES. 23.1 DEFINE EQUIPMENT CRITICALITY 23.2 SET UP PM ROUTINES FOR PMs & STANDARD JOBS	On any new equipment, there are a number of hand-off activities that are the responsibility of the Project Engineer, among them is to work with the Plant Engineer or Asset Specialist to set up the appropriate maintenance program and spares, and to define the equipment criticality using the approved methodology.

Role	Step ID	Step Title	Step Description
Process			**Creating New Equipment from a Capital Project**
Project Engineer	21.1	INITIATE RETIRE ASSET PROCESS. SWAP OUT EQUIP. RECORD.	IF THE PHYSICAL EQUIP. IS REPLACED, AND THERE IS AN EXISTING FIXED ASSET SPECIFIC TO THE EQUIPMENT FUNCTION, WITH AN EXISTING EQUIPMENT RECORD, THEN THE BEST APPROACH IS TO SWAP OUT BOTH THE FIXED ASSET AND THE EQUIPMENT RECORD TOGETHER, AND REPLACE THEM WITH THE NEW ASSET/EQUIPMENT.
	21.2	INITIATE RETIRE ASSET PROCESS. SWAP OUT FA RECORD.	IF THE PHYSICAL EQUIP.IS REPLACED, AND THERE IS AN EXISTING FIXED ASSET SPECIFIC TO THE EQUIPMENT FUNCTION, WITHOUT AN EXISTING EQUIPMENT RECORD, BUT WITH THE CORRECT PARENT ASSET #, THEN THE BEST APPROACH IS TO SWAP OUT THE FIXED ASSET RECORD, AND REPLACE IT WITH THE NEW ASSET.
	24.0	CREATE EQUIPMENT RECORD TAG FILE ON FIXED ASSET RECORD, UPDATE "MAINTENANCE ONLY" CATEGORY CODES, METER, OR WO Y/N CODES ON EQUIP.RECORD	If in either of the previous two steps, a new fixed asset is created, then a corresponding Equipment record must be created. The category codes designed for Maintenance use must be filled. The meter and "Work Order Allowed" check boxes must be filled with the appropriate values.

Role	Step ID	Step Title	Step Description
Process			**EQUIPMENT TRANSFER**
Long Term Asset Planning	30.0	UPDATE EQUIPMENT RECORD (LANO & AN8) WITH NEW AB#	WHEN EQUIPMENT IS TO BE TRANSFERRED WITHIN THE SAME COMPANY, BEYOND ANY DEPRECIATION ACCOUNT CHANGES, CHANGES ARE NEEDED TO SEVERAL OTHER ELEMENTS OFF THE EQUIPMENT RECORD: (1) SOME EQUIPMENT CATEGORY CODES; (2) BU LOCATION; AND (3) EQUIPMENT PARENT; (4) EQUIPMENT ADDRESS BOOK LOCATIONS; (5) PMS, (6) SPARE PARTS & BOMs.
	30.1	UPDATE "MAINTENANCE ONLY" CATEGORY CODES, METER, OR WO Y/N CODES ON EQUIP. RECORD	THE METER READINGS WILL STAY WITH THE EQUIPMENT WITHOUT ANY ADJUSTMENTS. THE PLANNER CODES OR ANY OTHERS SPECIFIC TO THE LOCATION OR SITE WILL HAVE TO BE ADJUSTED.
	30.2	CHANGE EQUIPMENT DESCRIPTION, RESPONSIBLE BU AS REQ'D.	IF THE EQUIPMENT IS VIRTUAL EQUIP. FOR MAINTENANCE PURPOSES ONLY (i.e. NOT A DEPRECIABLE FIXED ASSET), THEN THE DESCRIPTION WILL HAVE TO CHANGE, AND POSSIBLY THE RESPONSIBLE BUSINESS UNIT.
FIXED ASSETS	31.0	CHANGE EQUIPMENT DESCRIPTION, RESPONSIBLE BU AS REQ'D.	IF THE RECORD REPRESENTS BOTH A DEPRECIABLE FIXED ASSET AND A FUNCTIONAL EQUIPMENT, THEN TOO THEN THE DESCRIPTION WILL HAVE TO CHANGE, AND POSSIBLY THE RESPONSIBLE BUSINESS UNIT.
	31.1	CHANGE EQUIPMENT LOCATION BU.	IF THE RECORD REPRESENTS A DEPRECIABLE FIXED ASSET, THEN THE LOCATION BU MAY HAVE TO BE CHANGED AS WELL.

Role	Step ID	Step Title	Step Description
Process			**RETIRING / DISPOSING OF EQUIPMENT**
PROJECT ENGINEER	40.0	NOTIFY FIXED ASSETS AND ASSET MANAGER	IF EXISTING EQUIPMENT IS TO BE DISPOSED AS A RESULT OF PROJECT, THEN THE RECORDS IN THE ERP SYSTEM MUST BE UPDATED. THE APPROPRIATE PERSONNEL MUST BE NOTIFIED IN FIXED ASSETS AND IN THE PLANTS OR AREAS.
FIXED ASSETS	41.0	FA DISPOSAL SUB-PROCESS.	IF THE EQUIP. IS BOTH FA DEPRECIABLE FIXED ASSET AND A FUNCTIONAL EQUIP. FOR MAINTENANCE PURPOSES, THEN CHANGE EQUIP. DESCRIPTION TO "DISPOSED", EQUIP. STATUS TO APPROPRIATE DISPOSED CODE. CHANGE PARENT ASSET # AS REQ'D.
Long Term Asset Planning	42.0	UPDATE "MAINT. ONLY" CATEGORY CODES, METER, OR WO Y/N CODES ON EQUIP. RECORD	REGARDLESS OF WHETHER THE EQUIPMENT IS A FIXED ASSET, EQUIPMENT OR BOTH, THE ASSET RECORD SHOULD BE ADJUSTED SO THAT IT IS OBVIOUS FROM ALL THE SEARCH SCREENS THAT THE EQUIPMENT HAS BEEN DISPOSED AND TO ENSURE THAT NO MORE WORK ORDERS CAN BE CREATED AGAINST IT.
	42.1	CHANGE EQUIPMENT DESCRIPTION, STATUS & PARENT ASSET #	IF THE EQUIPMENT RECORD IS A VIRTUAL EQUIPMENT FOR MAINTENANCE PURPOSES ONLY, THEN THE AREA PLANNER SHOULD BE ABLE TO ADJUST THE RECORD. CHANGE EQUIPMENT DESCRIPTION TO "DISPOSED", EQUIP. STATUS TO APPROPRIATE DISPOSED CODE. CHANGE PARENT ASSET # AS REQ'D. IF A FIXED ASSET IS BEING REPLACED, AND IT IS ALSO A FUNCTIONAL EQUIPMENT RECORD, REMOVE THE UNIT NUMBER (REPRESENTING THE EQUIPMENT NUMBER AS FOUND ON FLOW DIAGRAMS OR SINGLE LINE DIAGRAMS) FROM THE DISPOSED EQUIPMENT AND ENTER IT ON THE NEW EQUIPMENT. ALSO CHANGE THE 'WORK ORDER Y/N' CODE ON THE DISPOSED EQUIPMENT TO 'N'.
	42.2	REVIEW SPARE PARTS HOLDINGS	REVIEW SPARE PARTS HOLDINGS AS A RESULT OF EQUIPMENT DISPOSAL. REDUCING THE EXISTENCE OF OR QUANTITY OF EQUIPMENT SHOULD HAVE AN IMPACT ON SPARES HOLDINGS. THERE ARE "WHERE USED" REPORTS TO BE RUN FOR EACH OF THE SPARE PARTS HELD FOR THE DISPOSED EQUIPMENT. THIS REQUIRES THAT EQUIPMENT PARTS LISTS AND PM BOMS HAVE BEEN CREATED AND ENTERED IN THE CMMS.
	42.3	TURN OFF PMs	TURN OFF PM SCHEDULES & PM LOOPS AS A RESULT OF EQUIP. DISPOSAL
	42.4	CLOSE OUT-STANDING WOs ON DISPOSED EQUIP.	CLOSE OUT ANY WOs IN BACKLOG FOR THIS EQUIP.

Role	Step ID	Step Title	Step Description
Process			**Creating New Combined Equipment and Fixed Asset Records**
Long Term Asset Planning	46.0	CREATE EQUIPMENT RECORD TAG FILE ON FIXED ASSET RECORD.	IF THERE IS AN EXISTING FIXED ASSET RECORD SPECIFIC TO THE EQUIP. FUNCTION WITH THE CORRECT PARENT ASSET #, AND THE APPROPRIATE ADDRESS BOOK LOCATION ALREADY EXISTS, THEN THE EQUIPMENT RECORD CAN BE CREATED USING THE FIXED ASSET RECORD AS A BASE. ALSO, UPDATE "MAINTENANCE ONLY" CATEGORY CODES, AND THE CHECK BOXES FOR METER AND WO Y/N ON THE EQUIPMENT RECORD
	46.1	CREATE VIRTUAL NON-DEPRECIABLE EQUIPMENT RECORD.	IF THERE IS NO EXISTING FIXED ASSET SPECIFIC TO THE EQUIPMENT FUNCTION, THEN CREATE A VIRTUAL NON-DEPRECIABLE EQUIPMENT RECORD, FILLING ALL DESCRIPTION, FINANCIAL & CAT. CODES. ENTER PARENT ASSET #.
	47.0	DEFINE EQUIP MAINTENANCE STRATEG; IDENTIFY TASKS; DEFINE CODES; SET UP EQUIP IN CMMS. SET UP PMs & STANDARD JOBS	47.0 DEFINE MAINTENANCE STRATEGY FOR EQP. IDENTIFY TASKS. 47.1 DEFINE EQUIPMENT CRITICALITY 47.2 SET UP EQUIPMENT RECORD(S) IN CMMS. 47.3 SET UP PM ROUTINES FOR PMs & STANDARD JOBS
ADDRESS BOOK MASTER OWNER	45.0	ADDRESS BOOK ADD/CHANGE SUB-PROCESS	A CHANGE TO THE ADDRESS BOOK LOCATION MASTER (AB SEARCH TYPE 'MA' OR A NEW AB NUMBER MAY BE NEEDED TO APPROPRIATELY CATEGORIZE THE NEWLY DISCOVERED EQUIPMENT

In this process, individual Units of Property are both Fixed Assets (quantity = 1) and also Inventory Items with separate Lot Numbers (Lot Quantity = 1). As such, they can be tracked in Inventory as well as being an Asset, from receipt in the warehouse through installation, disposal, and restock.

Role	Step ID	Step Title	Step Description
Process			**Replacing Asset that are also Inventory Items**
Maintenance Supervisor	RA 1.0	Mark Equipment Status of New Asset as "Asset Owner In Service"	In this scenario, as an example, a pole mounted transformer has been previously installed and is to be removed and replaced. The replacement transformer has an asset record and also has an inventory record, and is being issued from Stores. The Equipment Status "Asset Owner in Service" is recorded on the asset record by the Maintenance Supervisor to trigger action by Fixed Assets group to update the Asset record and begin depreciation.
	RA 1.1	Do Asset Swap	The Maintenance Supervisor can replace do an "asset swap" as part of changing the work order status. This removes the old asset and replaces it with the new asset. This process works best when dealing with Unit-of-property items like pole mounted transformers that are also inventory items. The transformers, when purchased, are already tagged with the transformer numbers. The extra configuration step when receiving the transformer from the vendor is to create both inventory records and individual, not group, asset records.
	RA 1.2	Preliminary evaluation of whether Removed Asset is Repairable	If the equipment is being upgraded (i.e. a 75 kVA transformer is replacing a 50 kVA transformer), then the removed 50 kVA unit may still be fit-for-service, and may still have a capital asset value.
ASSET OWNER	RA 2.0	Mark Equipment Status of Removed Asset as "Asset Owner Disposed Repair"	The Equipment Status "Asset Owner Disposed Repair" is recorded on the asset record by the Maintenance Supervisor to trigger action by Fixed Assets group to update the Asset record and cease depreciation by disposing of the asset.
	RA 2.1	Mark Equipment Status of Removed Asset as "Asset Owner Disposed Final"	The Equipment Status "Asset Owner Disposed Final" is recorded on the asset record by the Maintenance Supervisor to trigger action by Fixed Assets group to update the Asset record and cease depreciation by disposing of the asset.
	RA 2.2	Mark Equipment Status of Removed Asset as "Asset Owner Disposed Return to Inventory"	If the equipment is being upgraded (i.e. a 75 kVA transformer is replacing a 50 kVA transformer), then the removed 50 kVA unit may still be fit-for-service, and may still have a capital asset value. The Equipment Status "Asset Owner Disposed Return to Inventory" is recorded on the asset record by the Maintenance Supervisor to trigger action by Fixed Assets group to update the Asset record and cease depreciation by disposing of the asset.

Role	Step ID	Step Title	Step Description
Process			**Replacing Asset that are also Inventory Items**
Maintenance Supervisor	RA 3.0	Physically tag and Return to Stores for Repair Assessment	There are a lot of items being shipped to warehouses. The tag will record details of why the item removed from service is being shipped and what is to be done with it when it arrives in the warehouse (i.e. dispose, environmental disposal, repair and restock, take back to inventory)
	RA 3.1	Physically tag and Return to Stores for Disposal or Environmental storage, as appropriate	See 3.0
	RA 3.2	Physically tag and Return to Inventory	See 3.0

Role	Step ID	Step Title	Step Description
Process			**Replacing Asset that are also Inventory Items**
Fixed Assets	RA 4.0	Start Depreciation. Change Equip. Status to "In Service"	The use of the equipment status "Asset Owner in Service" is the trigger for the Fixed Assets group to set up depreciation for the fixed asset.
	RA 4.1	Dispose at $0 value. Change Equip. Status to disposed	If the item removed from service is to be repaired, or just disposed, then it is to be disposed at $0 value. Using either the status "Asset Owner Disposed Final" or "Asset Owner Disposed Repair" will be the trigger for Fixed Assets to write off any remaining asset value.
	RA 4.2	Dispose at $0 value. Change Equip. Status to disposed	See 4.1
	RA 4.3	Define "Disposal" value and "Return to Inventory" Value. Change Equip. Status to disposed	Under IFRS rules, an asset, once installed, cannot be re-capitalized. This means that, for example, if a used transformer were used where the transformer had been capitalized in a different installation, then the labour to install the transformer the second time could not be capitalized. It is also important to know what inventory is available, so "ghost" or unofficial inventories are discouraged. If the item is just being put back in inventory, and it has remaining asset value, the Fixed Assets group may have to determine remaining asset value prior to receiving the item into Stores. Xxx the accounts needed for this transaction need to be defined. Xxx Remember to get a new asset set up for the item being returned to Stores.
Stores	RA 5.0	Repairable Spares Procedure	Remember to get an asset set up for the repaired item before it is returned to Stores..
	RA 5.1	Investment Recovery Process or Environmental Disposal as appropriate	Refer to the Inventory "Investment Recovery" process and the Environmental standards for disposal of contaminated materials.
	RA 5.2	Receive Into Inventory	The item, if fit-for-service, is taken back into inventory at the value defined by Fixed Assets and with a new associated asset.

Appendix I – Definitions and Business Rules

1. Work Orders will be created at the lowest available level in the equipment hierarchy that allows work orders.
2. Standard equipment hierarchies will be implemented for the equipment or type of operation involved.
3. The lowest level of equipment for which work orders are allowed shall correspond to the defined “Functional Equipment Groups” (FEGs).
4. Depreciable equipment cannot be transferred between companies without being disposed in the old company and created anew as a separate asset in the new company.

Appendix 2 – Nalcor Location Code Examples

- BDE Bay D'Espoir
- BDEUNIT1 Bay D'Espoir Unit 1
- HLK Hinds Lake
- CAT Cat Arm
- CATUNIT1 Cat Arm Unit 1
- USL Upper Salmon
- USLWSDAM West Salmon Dam & Spillway
- CHF Churchill Falls
- CHFUNIT4 Churchill Falls Unit 4
- BLATS Bay L'Argent Terminal Station
- MDRTS Massey Drive Terminal Station
- HBYTS Hawkes Bay Terminal Station
- HBYDSLGEN Hawkes Bay Diesel Plant
- HBYUNIT1 Hawkes Bay Diesel Generator Unit 1
- HBYDIST201 Hawkes Bay Distribution System 201
- SVLGTGEN Stephenville Gas Turbine
- For Transmission Lines, just use the line number (i.e. TL236)
-

Appendix 3 – Standard Equipment Hierarchies and Type Coding

Supplemental Data on Assets that are children of Functional Equipment

Should it be desired to store specification or supplemental data against an asset record that is a child of a Functional Equipment, then it is convenient to use the same equipment application to see that asset as is used to view the parent Functional Equipment. In order to accomplish this, an equipment record (F1217) should be created for the asset containing the supplemental data and the "Allow WO?" (F1201:WOYN) field set to "N".

- The Customer and Site Address Book Location fields (F1201:LANO & F1201:AN8) should be set the same as the next immediate parent Functional Equipment in the asset hierarchy.
- The Product Model and Family fields can also be set the same as the next immediate parent Functional Equipment in the asset hierarchy.

Creating Equipment that are children of Functional Equipment

Should it be desired to create work orders at a level in the equipment hierarchy that is a child of a Functional Equipment, then this is possible, but not usually recommended. In order to accomplish this, an equipment record (F1217) should be created for the asset containing the supplemental data and the "Allow WO?" (F1201:WOYN) field set to "N".

- The Customer and Site Address Book Location fields (F1201:LANO & F1201:AN8) should be set the same as the next immediate parent Functional Equipment in the asset hierarchy.
- The Product Model and Family fields has to be set the same as the next immediate parent Functional Equipment in the asset hierarchy.

Product Model – Product Family Combinations

Product Family Code	Product Family Description	Product Model Code	Product Model Description	Component Tree Available?
SAUX	Auxiliary Systems/Equipment	SACSS	AC Station Service	
		SCMPA	Compressed Air System	
		SDCSS	DC Station Service	
PY	Building & Property	BGAH	Building - Accommodation & Housing	
		BGEE	Building - Equipment Enclosure	
		PYINTK	Intake Structure	
		PYPH	Powerhouse	
		PYPR	Property	
		PYWH	Warehouse	
SCMPA	Compressed Air System	ADRY	Air Dryer	
		ARECV	Air Receiver Tank	
		ACOMP	Compressor	

S	System	SPV	Pressure Vessel	
		SACC	Accumulator	
		SWT	Water Treatment System	
		SWWT	Waste Water Treatment System	
		SPIPING	Piping System	
		SENVM	Environmental Monitoring System	
		SAUX	Auxiliary Systems/Equipment	
		SCOMM	Communication System	
		SCLGW	Cooling Water Systems	
		SDIESL	Diesel System	
		SDIST	Distribution System	
		SEXCT	Excitation System	
		FPS	Fall Protection System	
		SFSS	Fire Sprinkler/Deluge System	
		SFWM	Fire Water Mains	
		SFGA	Gaseous Fire Suppression System	
		SCLRS	Generator Coolers	
		SGOV	Governor System	
		SGRD	Grounding System	
CE	**Control Equipment**	DVC	Distribution Voltage control	
CL	**Control Logic**	DCS	PLC/DCS/SCADA	
SDCSS	**DC Station Service**	SBATT	Battery System	
DP	**Diesel Plant**	DPE	Diesel Plant Equipment	
XFMRD	**Distribution Transformer**	XFDPM	Distribution Transformer - Pad Mount	
		XFDPL	Distribution Transformer - Pole Mount	
		XFSS	Station Service Transformer	
XFMRBD	Distribution Transformer Bank	XFDBPM	Distribution Transformer Bank - Pad Mount	
		XFDBPL	Distribution Transformer Bank - Pole Mount	

EG	**Electric Generator**	EGCT	Electric Generator - Combustion Turbine Driven	
		EGED	Electric Generator - Engine Driven	
		EGST	Electric Generator - Steam Turbine Driven	
		EGWT	Electric Generator - Water Turbine Driven	
		EGWNDT	Electric Generator - Wind Turbine Driven	
		HPVDC	125 VDC Systems	
		HPAUX	Auxiliary Equipment	
		HPCAP	Capital Spares	
		HPCMPA	Compressed Air	
		HPCLGW	Cooling Water Systems	
		HPEXCT	Excitation System	
		HPCLRS	Generator Coolers	
		HPGOV	Governor System	
		HPBRG	Main Generator Bearings	
		HPPNC	Protection and Controls	
		SAFE	Safety Equipment and Systems	
		HPSS	Station Service	
		HPTLS	Tools and Test Equipment	
		HPTRBN	Turbine System	
FS	**Fuel System**	FSHS	Fuel Storage & Handling System	
TLHV	**High Voltage Transmission Line**	TLSTR	Transmission Line Structure - Steel	
		TLSTRW	Transmission Line Structure - Wood	

PD	**Power Distribution**	XFDPM	Distribution - Pad Mounted Transformers	
		DSS	Distribution - Substation	
XFMRP	**Power Transformer**	XFPPM XFPPL XFVR	Power Transformer - Pad Mount Power Transformer - Pole Mount Voltage Regulating Transformer	
XFMRBP				

Asset Hierarchy Templates

Transmission Line Asset Hierarchy

Asset Description	Work Orders Allowed?	Equipment Record Needed?	Product Family	Product Model

Appendix 4 – Standard Equipment Location Abbreviations

Standard 3 Letter Community and Plant Codes

Code	Description
ANP	Anchor Point
BAB	Bakers Brook
BAI	Barrd Island
BCN	Bear Cove North
BCS	Bear Cove South
BCV	Bear Cove
BCX	Barachoix
BDC	Black Duck Cove
BDE	Bay D'Espoir
BED	Beachside
BES	Beaches
BGB	Brig Bay
BGH	Blue Grass Hill
BHC	Burnt Head Cove
BHL	Berry Hill
BIA	Bide Arm
BIC	Bird Cove
BIF	Bishops Falls
BIH	Birchy Head
BKT	Black Tickle
BLA	Bay L'Argent
BLB	Belburns
BLC	Blue Cove
BLP	Belldowns Point
BMN	Beaumont North
BMS	Beaumont South
BMT	Beaumont
BOX	Boxey
BRC	Brents Cove
BRH	Bartlett's Harbour
BRK	Bottom Brook
BRM	Belloram
BRT	Brighton
BSD	Bayside
BTH	Boat Harbour
BUC	Buchans
BUD	Burnt Dam
BUH	Burnt Hill
BUL	Burlington

BUR	Burgeo
BVM	Baie Verte
BWT	Bottom Waters
CAB	Camp Boggy
CAI	Capstan Island
CAM	Coney Arm
CAT	Cat Arm
CBA	Capr Bauld
CBC	Come by Chance
CBF	Corner Brook
CFC	Coffee Cove
CHD	Cow Head
CHF	Churchill Falls
CHT	Charlottetown
CIS	Change Islands
CMC	Coombs Cove
CNO	Cape Norman
COC	Coachmans Cove
COH	Cooks Harbour
CON	Conche
CPO	Cape Onion
CRQ	Croque
CRR	Castors River
CRV	Conne River
CTW	Cartwright
CUZ	Curzon
DAC	Dawsons Cove
DAV	Davis Inlet
DEB	Deep Bay
DEC	Deadmans Cove
DHR	Daniels Harbour
DLK	Deer Lake
DLS	Doyles
DMM	Dome Mountain
DOC	Dock Cove
DOM	Domino
EAB	Eastern Brook
EBE	Ebbegunbaeg
EDC	Eddies Cove
EHW	English Hr. West
ENG	Englee
ENP	English Point
FDL	Fleur de Lys

FGO	Fogo
FHD	Farewell Head
FLC	Flowers Cove
FOA	Fortune Arm
FOP	Forresters Point
FRC	Frankies Cove
FRS	Francois
FRU	Forteau
FXC	Fox Cove
GAU	Gaultois
GBA	Grand Bay
GBH	Great Brehat
GBK	Grandy Brook
GBU	Grand Bruit
GBY	Goose Bay
GDH	Godfathers Cove
GDY	Goodyear
GFC	Grand Falls
GIB	Green Island Brook
GIC	Green Island Cove
GLB	Glenburnie
GOC	Goose Cove
GOH	Godaleigh Hill
GPH	Gull Pond Hill
GQT	Griquet
GRL	Granite Lake
GRO	Grole
GRP	Green Point
GRS	Grandois
GUC	Gunners Cove
GWD	Glenwood
GYR	Grey River
HAB	Hare Bay
HAH	Harrys Harbour
HAW	Haywards Cove
HAY	Hay Cove
HBK	Hope Brook
HBR	Harbour Breton
HBY	Hawkes Bay
HDE	Harbour Deep
HDN	Hampden
HEB	Head of Bay D'Espoir
HKD	Hawke Hill

HLK	Hinds Lake
HLY	Howley
HPD	Hopedale
HRD	Holyrood
HRL	Harrie Lake
HRO	Harbour Round
HTG	Hermitage
HVY	Happy Valley
HWD	Hardwoods
HYP	Hydro Place
IRV	Indian River
ISH	Island Harbour
JAC	Jacksons Cove
JAM	Jacksons Arm
JBA	Joe Batts Arm
KGH	Kings Harbour
KGP	Kings Point
KOB	Kona Beach
LAA	L'Amour
LAC	L'Anse au Clair
LAD	L'Anse au Diable
LAL	L'Anse au Loup
LAM	L'Anse au Meadows
LAP	Lapoile
LAS	LaScie
LBC	Labrador City
LBI	Little Bay Islands
LBY	Little Bay
LGC	Langdon Cove
LHR	Long Harbour
LIB	Lushes Bight
LLK	Linton Lake
LOB	Lodge Bay
LOC	Lobster Cove
LSD	Little Seldom
LWC	Lower Cove
MAK	Makkovik
MBK	Main Brook
MCC	McCallum
MDL	Mud Lake
MDR	Massey Drive
MFA	Muskrat Falls
MIA	Middle Arm

MIB	Mings Bight
MIC	Miles Cove
MKS	Monkstown
MLT	Milltown
MMH	Mary March Hill
MOA	Mose Ambrose
MRV	Morrisville
MSH	Mary's Harbour
MSM	Mount St. Margaret
NAC	Nameless Cove
NAN	Nain
NEF	New Ferrole
NHR	Neddy Harbour
NIH	Nippers Harbour
NNC	Nickey's Nose Cove
NOB	Norman Bay
NOD	Noddy Bay
NOP	Norris Point
NWR	Northwest River
OPD	Oxen Pond
PAC	Port au Choix
PAH	Paynes Harbour
PAI	Pass Island
PAQ	Pacquet
PBN	Peters Barren
PDC	Pond Cove
PEF	Petit Forte
PET	Petites
PGC	Pigeon Cove
PHS	Port Hope Simpson
PIA	Pinsents Arm
PIW	Pinware
PLD	Portland Creek
PLI	Pilleys Island
PNC	Pines Cove
POA	Port Anson
POC	Pools Cove
POP	Pollards Point
POR	Point Rich
POS	Port Saunders
POV	Postville
PPD	Parsons Pond
PPT	Plum Point

PRB	Paradise River
PUC	Purbecks Cove
PUD	Pudops
QUP	Quirpon
RAB	Rattling Brook
RAL	Raleigh
RAM	Ramea
RAR	Roberts Arm
RCE	Rencontre East
REB	Red Bay
REH	Reefs Harbour
RHC	Rocky Harbour Cove
RHR	Rocky Harbour
RIG	Rigolet
ROH	Round Harbour
ROM	Rooms
ROP	River of Ponds
RWC	Roddickton
SAB	St. Anthony Bight
SAL	St. Albans
SAM	Snooks Arm
SAV	Sandyville
SBA	St. Barbe
SBH	Sandy Brook Hill
SBK	Shoal Brook
SBN	St. Brendans
SBY	Shoal Bay
SCA	St. Carols
SCB	Seldom Come By
SCC	Schooner Cove
SCF	Sandy Cove (Fogo)
SCG	Sandy Cove (GNP)
SCR	Savage Cove
SCV	Sally's Cove
SDM	Seldom
SEB	Sourheast Bight
SGC	Swangers Cove
SGE	St. Genevive
SHC	Shoe Cove
SHO	Shoal Cove
SID	Silverdale
SJA	St. Jacques
SJC	St. Josephs Cove

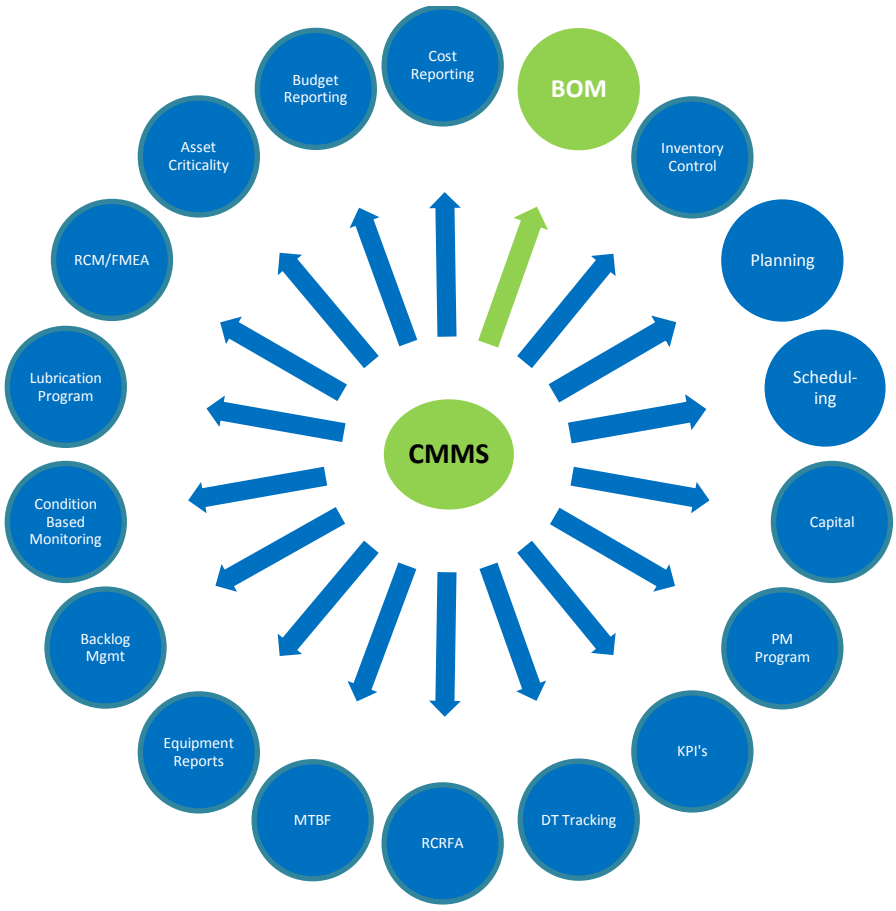
SJU	St. Julians
SLE	St. Lewis
SLU	St. Lunaire
SMH	Smiths Harbour
SOA	Sops Arm
SOK	South Brook
SPC	Ship Cove
SPK	St. Patricks
SPL	Springdale
SPS	St. Pauls
SRF	Seal Cove
SSD	Sunnyside
STA	St. Anthony
STB	Stoney Brook
STH	Stag Harbour
STV	Straitsview
SVE	St. Veronicas
SVL	Stephenville
SWC	South West Crouse
SYC	Shalloway Cove
TIC	Tilt Cove
TIL	Tilting
TMR	Three Mile Rock
TRR	Trout River
TRT	Triton
TWF	Twin Falls
USL	Upper Salmon
VBT	Bvenam's Bight
VIC	Victoria
WAB	Wabush
WAV	Western Avalon
WDL	Wiltondale
WEP	Westport
WHB	Whitbourne
WHR	Williams Harbour
WIB	Wild Bight
WIC	Wicks Cove
WOO	Woodstock
WOP	Woody Point
WRC	Wreck Cove
WSM	West St. Modeste
WTB	Winterhouse Brook

Corporate Business System - ERP Assessment

Business Process Document

Maintenance Work Centers - Asset Management

December 20th/2016



Version	Date	Description of Revision	Author
	2016-12-20	Updated after process review	S. McCarthy

Contents

Purpose

Work Centers, (Crafts or trades) define groups of Maintainers under general trade classifications. Work Centers are the basis for planning labour on work orders and for comparisons to crew labour capacity available to perform that work. Defining Work Centers is one key process which supports effective maintenance planning and scheduling.

Work Centers are defined at the Branch/Plant level, where the Branch/Plant is defined as the source of resources, both material and human.

The intent of this procedure is to ensure that Work Centers are defined at an appropriate level of detail to aid in Maintenance Planning and Scheduling.

What is a Work Center?

- Work Centers are used to Plan and Schedule Work Orders at a Craft level.
    - Labour plans are constructed by Craft.
    - Schedules are loaded by Craft.
    - Maintenance Backlog is measured by Craft.
- Crafts are "loaded" to the desired level in the weekly and 30 Day schedules. Schedule loading is the percent of available craft capacity utilized in a schedule.
    - Detailed Craft estimating must be done in order to move to higher levels of Scheduling Maturity using the CMMS.
- Crafts are not defined to a trade competency level. Typically, an Electrician is an electrician, and a welder or millwright is a mechanic. Keeping track of certifications or competencies in certain skills or equipment is done at a level of detail below the craft.
- Crafts may be defined by area, if there are different crews assigned to those areas (i.e. "North" and "South") and the geographic boundaries of the area are defined.
- Central Maintenance groups like personnel dedicated to Machine Shops need to be a different craft than area maintenance crafts, since scheduling central maintenance groups is usually an iterative process bringing together and reconciling the area scheduling requirements for the Central Maintenance crafts.
- Crafts are not defined by pay rate, job classification within a trade or in a union agreement, or progression steps within a classification (i.e General Maintenance "A" and "B" should just be "General Maintenance")
- If a Maintainer is to be charged out through recharge time writing, then that person should be assigned to a craft which has a rate.
- Equipment is usually not defined as a craft in Maintenance environments. If it is necessary to schedule equipment, this should be done by defining the equipment as a resource in the Maintenance Scheduling process.

Business Process – Work Centers

Creating Work Center Business Units

Work Center Business Unit creation consists of two steps:

1. Create the Work Center BU Master (F0006)
2. Assign the Category Code on the BU Master that defines the basic trade type.

Creating Work Center Masters and Assigning Rates

A rate is assigned to a Work Center for estimating purposes if the cost of that trade is going to be recovered through Recharge Time Writing.

The hourly rate assigned to the Work Center Master also has to be set up on the recharge rate associated with the employees who are associated with that Work Center.

Work Center Masters are created in two steps:

1. Create the Work Center Master Record and set the hourly rate.
2. Fix the “Frozen” Rate by running the batch update report.

Approvals

	(name)	(signature)	(yyyy/mm/dd)
	(name)	(signature)	(yyyy/mm/dd)

Appendix I – Definitions and Business Rules

<< Add any agree upon business rules or definition associated to the business processes.>>

Business Process

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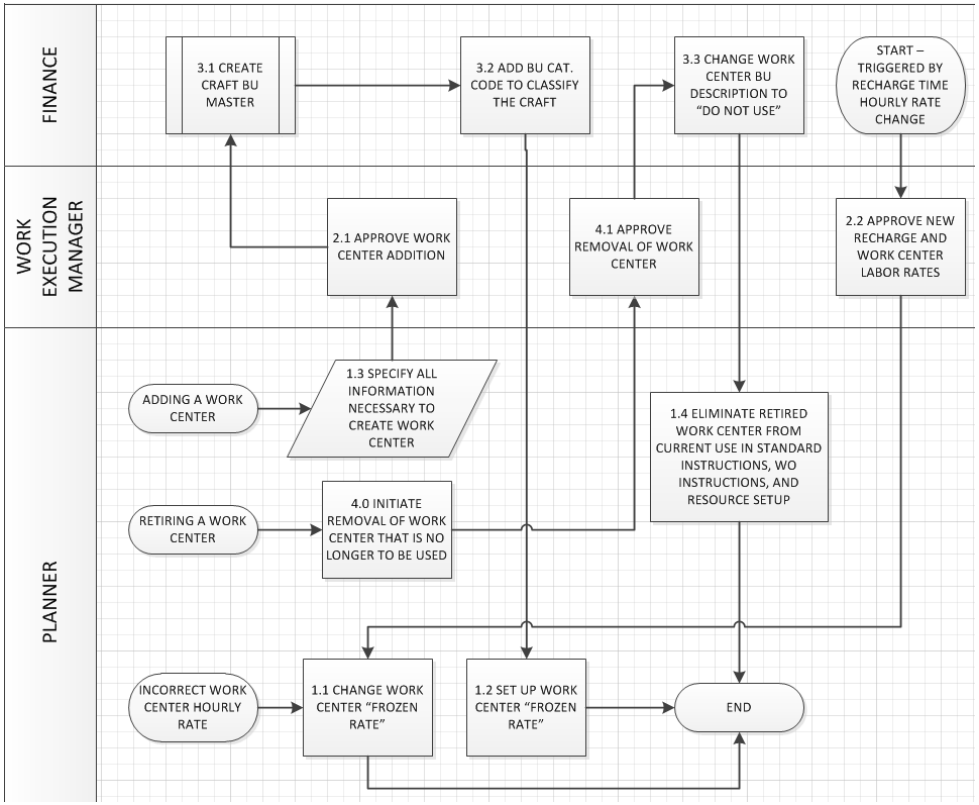


Role	Step ID	Step Title	Step Description
Planner	1.1	CHANGE WORK CENTER "FROZEN RATE"	If the Work Center Hourly Rate is incorrect, and the appropriate rate has been approved already, then the frozen hourly rate needs to be adjusted.
	1.2	SET UP WORK CENTER "FROZEN	After a new Craft BU is set up, the next step is to set up the Frozen hourly rate.

Role	Step ID	Step Title	Step Description
		RATE"	
	1.3	SPECIFY ALL INFORMATION NECESSARY TO CREATE WORK CENTER	In order to create a New Work Center, the addition must first be approved by the Work Execution Manager. All the data must be submitted for approval, including the name (using the naming standard), the members of the Craft, the estimating hourly rate, how the creation of the craft will affect other crafts or their membership, and the generic craft code to be assigned to the Work Center BU for backlog reporting purposes.
	1.4	ELIMINATE RETIRED WORK CENTER FROM CURRENT USE IN STANDARD INSTRUCTIONS, WO INSTRUCTIONS, AND RESOURCE SETUP	When a Work Center is to be retired, then it should be changed in order that it will no longer be used. Also, any active places where the Craft is used should be changed.
	4.0	INITIATE REMOVAL OF WORK CENTER THAT IS NO LONGER TO BE USED	
Work Execution Manager	2.1	APPROVE WORK CENTER ADDITION	What a new Work Center is requested, the Work Execution Manager has the responsibility to approve the addition, with advice from the Planner or whomever else is felt necessary to consult.
	2.2	APPROVE NEW RECHARGE AND WORK CENTER LABOR RATES	If the recharge rates have been recalculated, and the analysis shows that a change is needed, then the Work Execution Manager has the responsibility to approve the change, with advice from the Planner or whomever else is felt necessary to consult.
	4.1	APPROVE REMOVAL OF WORK CENTER	
Finance	3.1	CREATE CRAFT BU	Work Centers are Business Units, and as at 2015-August are the responsibility of the

Role	Step ID	Step Title	Step Description
		MASTER	Finance group to add or change, regardless of whether they are “Financial Business Units” (i.e. with accounts and transactions) or not.
	3.2	ADD BU CAT. CODE TO CLASSIFY THE CRAFT	The BU generic craft code to be assigned to the Work Center BU for backlog reporting purposes must be added by Finance, since as at 2015-August are the responsibility of the Finance group to add or change, regardless of whether they are “Financial Business Units” (i.e. with accounts and transactions) or not.
	3.3	CHANGE WORK CENTER BU DESCRIPTION TO “DO NOT USE”	When you retire a Work Center, it is appropriate to change the BU description so that the craft will obviously be not in use. It is important that Finance not delete Business Units (F0006) and leave the Work Center Master files (F30006 & F30008) in place.

Corporate Business System - ERP Assessment

Business Process Document

Planning - Asset Management

September 12th/2018

Version	Date	Description of Revision	Author
R0	2016-12-20	Updated after process review	S. McCarthy
R1	2018-09-12	Updated with AM Champions comments	S. McCarthy

Contents

Purpose

Planning and Scheduling determines when work should be performed based upon priorities, the availability of personnel, material, parts, outside resources, transportation, and the equipment criticality. This allows for optimizing resources and minimizing downtime.

Planning and scheduling are two distinct activities. Maximum efficiency is achieved when properly planned jobs are scheduled and executed in accordance with the schedule.[1]

- Planning – the analysis and determination of the required information, materials, human resources, time, tools, procedures, safety requirements, permits and procedures.
- Scheduling – determining when an activity can be accomplished based on available resources and the scope of work[2].

Planning is the process of breaking down work into manageable activities. This is achieved by using the details within a work order system to identify the required Materials, Labour and resources. This is used to evaluate estimated costs and timing required to complete these activities[3].

Planning processes or tasks should include the following process flows, or have a Company Procedures which should include the following:

- Field scoping (as required)
- Materials (Materials Plan)
- External services
- All Job steps, including Operations, Scaffold, etc.
    - Scaffolding erection and removal are separate steps.
    - Equipment removal and replacement are separate steps only if separated by the work or another trade or removal and replacement will be done in different scheduling periods.
- Identification of and linking to the applicable “Safe Work Methods”.
- Job safety assessment including Permit to Work requirements identified
- Job Procedures
- Post-work testing requirements
- Monitoring of Backlog
    - Validate Priority
    - Eliminate Duplication

[1] Revision 1: Some efficiency gains are possible through scheduling alone, which may help to avoid delays in equipment release for maintenance and isolation/de-energization. Proper scoping and planning are essential to avoiding delays in acquiring materials and equipment return to service.
[2] Revision 1: Scheduling needs to consider work scope and the equipment condition required to complete the tasks on the work order.
[3] Revision 1: Multiple trades necessary to complete a job are included on a single work order, using routing steps.

    - Assign proper responsible group or organization
    - Assess Equipment condition for Work Order and impact on Production
- Labor by skill and estimating Resource Requirements - Man-hour estimates & durations, based on execution by an experienced technician, without unforeseeable delays [4] for:
    - Internal resources (employees or core (embedded) contractors)
    - External – Contracted resources
    - Major tools or Equipment
- Estimating Materials
    - Internal – Inventory issues
    - External – Direct Purchase
- Expediting and follow up for Purchase Orders
- Hand over to Scheduling personnel – Propose start date
- Continuous improvement
    - Monitor PM work Plans against actual and feedback to appropriate PM Planner
    - Feedback results for Continuous improvement.

The Planning objective is to help boost labour productivity and improve equipment availability, and not to provide perfect time estimates. The time required to perform the same maintenance tasks is variable because field and equipment conditions vary. We provide time estimates for work orders because:

- Schedulers need time estimates to help schedule work assignments.
- Maintenance Supervision needs a time estimate in order to assign and control work assignments.

The time estimate used for any task (a routing step or operation on a work order) should be the amount of time it takes for a competent worker to perform the defined work activity at the required level of quality, under optimum operating conditions. The estimate should not include allowances for lost time, exceptional conditions, waiting time, or travel. Through the estimate, the Planner sets a standard for performance, and not an ambitious target or goal.

Business Process - Planning Work Orders

Gate Keeper

Planning does not include the following "Gate Keeper" activities. The Gate Keepers should be able to represent Operation Personnel, Maintenance, and Asset Specialist to code and promote new work (good work) to be assessed by Planning. This position allows the Planning Group to focus actively on planning and coordinating the efforts of fully scoping work orders.

[4] Revision 1: Unforeseen delays are those that the Planner could not reasonably predict. The identification of Unforeseen delays is a critical aspect of planning improvement, an input to closer alignment of estimated versus actual work order cost, and one outcome from Schedule Compliance reviews.

Local procedure shall be in place to identify the following for Work Order Accuracy:

- Accept/Approve or reject New Work Priority
- Eliminate Duplication
- Identify requirement against long term plan
- Description – Clarify the problem, and extent of what the plan should include [5](repair, replace)
- Additional coding – failure, reporting ….. required to support ongoing assessments
- Proper Equipment identification
- Cost accounting (Ops vs. Capital)
- Estimated Start Date (first cut requirement)
- Required Date Complete
- Promote to Planning
- Approve as Break in Work – Emergencies or Break in Work bypasses the Planning stage and goes directly to active work.

Additional related activities for the Gate Keeper role but not defined in this document

- Receive feedback from planning – where job scope creep occurs or planning process reveals that the work cannot be executed prior to the Planned Complete Date
- Receive feedback from Scheduling – when complete dates are going to be missed work orders need to be reprioritized.

Planning Level of Detail

If Planners put too much detail into individual work orders, then they won't get all the work planned. It is always better to plan 100% of the work hours than to turn unplanned work over to Work Execution. It is the Planners responsibility to take the new work promoted from the Gate Keepers, to assess and scope these jobs. It is up to the planning personnel to feedback any scope creep that was found during the planning process to the Gate Keepers and or the Work Execution Managers. The level of detail or completeness of job packages can be broken up into several categories. The accepted level of planning needs to be completed before forwarding these jobs on to the Scheduling process. In all cases estimated hours need to be assigned. Planning LOD can be broken up into the following categories:

- Minimal Planning - It is generally not cost effective to spend excessive time planning certain small jobs. Jobs that are considered needing Minimal Planning will just have job duration and manpower requirements planned (craft/skill needed, number of persons, and total craft labour hours needed). Typically, jobs that fit into the Minimal Planning category should have an agreed upon company standard, the following are examples:
    - Work less than 4 work hours – usually one step activity

[5] Revision 1: It is a fallacy to say that most corrective jobs can't be planned until the equipment is opened up and inspected. This is not true of proactive corrective work, since trouble shooting can be done to further define the problem. It is not true of many reactive corrective jobs, since experience and history should offer clues to the scope of work, and consequently the resources needed.

    - Materials/parts common and available (No ordering or reserving needed)
    - No production impact
    - Simple Work routine with hazards that are well understood. The Planner is responsible for making the decision as to whether to minimally or extensively plan the work. Work that is to be minimally planned proceeds directly to manpower requirements. The Description of work is identified in the Work Order description field.
- PM or Routine Standard Jobs: (not triggered by PM Scheduler but by condition) – These jobs can be identified as fully planned, or scoped, and are the accepted standards for the site. These jobs do not require planning as much as verifying dates and availability of parts or contract requirements.
- Fully Planned – these are where the bulk of a Planner's time will be consumed. The Maintenance Planner is responsible to identify all the work required to accomplish a job. The job plan or scope typically includes:
    - A site visit (recommended when feasible) – It is important to understand the Planner's expertise for the equipment and work scope; if the Planner has the necessary experience this is not a requirement. *If in remote areas* additional Maintenance support may assist with this step.
    - A review of the maintenance history for the equipment, in order to identify foreseeable delays and design mitigations.
    - The key steps/tasks in the job and time assessments.
    - Tools and special equipment for the completion of the job
    - Material list – both Warehouse controlled and Purchase requirements
    - Special job safety requirements (confined space requirements, hot work, scaffolding, etc.). Which equipment will be required to be shut down to proceed (outages required)
    - Required drawings, schematics, etc.: Special expertise may be required to properly plan some jobs. The planner may need to enlist the support of specialists (such as a vibration analysis technician, engineering, etc.) in order to properly develop a job plan. Most work, however, is routine and should not be difficult to plan.
    - Purchase Requests for external materials, Service Orders and Rental requirements

Regardless of whether the work order is fully or minimally planned, standard repair procedures and standard documents associated with the work should be attached to the work order.

The plan is documented in the Routing steps (tasks or operations) in the Work Orders' Labour Plans. The intent of the labour plan is not to merely provide an overall estimate of labour requirements in hours, but rather to lay out the steps necessary to progress the work in the appropriate order, by trade, each with a labour estimate (duration and crew size).

- Include separate steps for scaffolding construction and removal, where another trade has to use the scaffold to perform some intermediate task..
- Include separate steps for insulation removal and replacement, where some other trade has a task to be performed once the insulation is removed.

- Disassembly and re-assembly may be different steps depending on the duration or whether there is some other intermediate step.
- Include steps for tasks that have to be performed by Work Execution after the equipment is ready for return to service, such as confirmation of vibration levels after an alignment on rotating equipment, where appropriate.

It is not the intention of the individual routing steps to define a detailed process or maintenance procedure. Standards and procedure documents may be attached to the work order or to individual routing steps.

- Planners count on the workforce being sufficiently skilled so that a minimal level of detail can be put into the job plans.
- Planners must respect that the Maintainers know how to do the job, and there are frequently several acceptable ways to perform any task. (If there is one best way to perform a job, or if best practices have been defined, then the task should be the subject of a standard or directive) The Planner should describe in the Routing Steps what needs to be done, and not necessarily how best to accomplish it. The Planner's responsibility is to provide value through scoping and scheduling, and to attach standards that have already been developed.
    - In any plant or area there is a base trade-by-trade assumption of the trade's knowledge, which is analogous to the toolbox carried by each Maintainer. Above that, Maintenance Procedures define how to perform tasks where special knowledge or controls are needed; which is analogous to the Special Tools held in the tool crib. The Planner is responsible to ensure that "What to do" is defined, with an appropriate estimate.
    - Each task description or its associated text should contain an Item and a Task, and where appropriate, a Specification.
        - The Item is where or on which component the task is to be carried out (I.e., "Air Filter").
        - The Task is what has to be done (i.e. "Clean").
        - The Item and Task meet the basic requirements for a Planner, but for important tasks the detail should be improved to define how to perform the task. The Planner cannot write a Specification for each step and still expect to be able to plan all of the crews' work. If a procedure exists, the Planner should reference it. There must be a process to write procedures for critical tasks, and make them available to Planners and Maintainers to reference when needed.
- Routing steps should have no shorter duration than one half hour.
- Routing steps should never be longer in duration than a weekly scheduling period. (For shutdown work and closely managed projects, the maximum duration should be reduced to one shift)
- Routing steps, like work orders, should have a defined scope and defined start and end points.
- When describing a task, Planners should never use the word "Check" without following it with a defined standard.

Strict adherence to the Job Plan is not required as long as feedback is provided from Work Execution to the Planner at Job Completion, in order that the job plan may be improved the next time the same work scope comes up.

Defining and Assigning Crafts (Work Centers or trades)

A craft is defined by a major trade group and a geographical area. Refer to the Work Centers procedure for more detail.

Crafts should be assigned to each task using the lowest competency level that can perform the work. During work assignment, anyone can be assigned to any task only limited by jurisdictional agreements.

Planning and Reporting Travel Time

For work orders that are to be executed at sites remote from the home base of the Work Execution group (i.e. Maintenance):

1. Estimate travel time on work orders using separate routing steps.
2. Estimate travel time on each Corrective work order as if the work order would be scheduled by itself at that location and for that crew.
3. Do not include an estimate for travel time on PM Work Orders. The work order labor estimate should be for the real work person-hours needed to perform the defined scope of work on the work order.
    a. The use of Standing Work Orders and Non-Maintenance Work Orders for the purpose of tracking Maintenance Travel time is not approved practice. Such practice would open the door to the use of Standing Work Orders for "collecting costs" for maintenance activities, and that is a worse problem than any perceived lack of accuracy in Work Order Costs.
    b. This assumes that the PM Activities in each area will be scheduled and grouped so that they may be performed in the most efficient manner.
    c. When building the weekly schedule, or where the Scheduler is bundling "opportunity work orders" together for an area, the Scheduler may add or adjust a routing step for travel time for each trade to a one or more work orders for each location or business unit and include the travel hours expected.
4. Reporting Travel Time is covered in this procedure to provide an overall view of how estimates and actual values match up, and because accurate time and cost reporting are inputs to future plans.
    a. If there is a single work order to be performed at the remote site, then the travel time will be reported to the Work Order involved.
        i. If the job is Planned and Scheduled, then the time will be written to the Work Order and potentially also to the routing step for travel.
        ii. If the job is unplanned, then the time will be written to the Work Order.
    b. If there are multiple work order to be performed at the remote site:
        i. If the jobs are Planned and Scheduled, then the time will be written to the Work Order(s) that have time estimates and potentially the routing step(s) for travel.

ii. If the jobs are unplanned or incompletely scheduled, then the time will be written to a Work Order most representative of the reason for being at the remote site, or one selected by the Maintenance Supervisor.

c. Any extra or unforeseen travel time associated with a single work order may be charged to that work order.
d. There will be a separate Pay Type for reporting travel time.

Reporting Planner Time

Planners shall not report time to work orders for repairs, maintenance, or improvements. Planners are overhead to the Work Execution function and their payroll and overhead costs should be included in the numerator for the calculation of the Maintainer recharge rates.

Validation of the Work Order Planning Process[6]

- Confirm that Gate Keepers review all new work orders of all types and require that the work scope be defined before sending the WO for planning, as much as possible.
- An assessment should be made of the level of awareness of the Work Order Planning procedure through interviews with Maintenance Planners and observation of gate keepers.
- Work Orders should be sampled to assess the level of adherence.
- Planers' and Gate Keepers' Training records for this process should be reviewed.
- There should be evidence that the effects of foreseen delays are mitigated through Planning.
- There should be evidence that unforeseen delays are identified and are one source of continual improvement guidance provided to, and used by, Maintenance Planners.
- There should be a local process, approved by area management, defining in what ways this process is implemented across the local area, including scope and personnel or position assignments, and exceptions associated with specific work order types.

Planning Metrics

Metrics used as KPI's for the Planning function

- Percent Work Planned
- Percent Proactive Repair Work
- PM Compliance
- Backlog by Craft (measured in weeks and trended over a rolling twelve month period)
- Planning Efficiency - estimated (scoped) hours vs. actual (booked) hours (absolute value)
- Steady and continual improvement of existing standard repair plans and procedures, based on feedback from schedule compliance and from work execution.
- Number of Reactive Maintenance Work Orders with Planning Complete, but awaiting materials or services (trend)
- Number of work orders planned per week by Planner.

[6] Revision 1: Added the "Validation.." section.

- Reactive Backlog by work center (trade)
- Repair backlog by trade.
- Percent non-stock requests achieving required on-site date based on WO Planned Start Date.
- Percent Unplanned work executed.
- Number of work orders completed and awaiting review by Work Execution, and by Planner (trend)
- Number of Repair Work Orders completed with no failure coding or insufficient detail in the failure coding.
- Number of Repair Work Orders coded with “Other” in any Failure code.
    - Review work orders to confirm text added to describe what the “Other” Failure Code means.
- Percent of Work Orders completed with no reported labour hours – by WO Type and by Supervisor or Main Trade.

Approvals

	(name)	(signature)	(yyyy/mm/dd)
	(name)	(signature)	(yyyy/mm/dd)

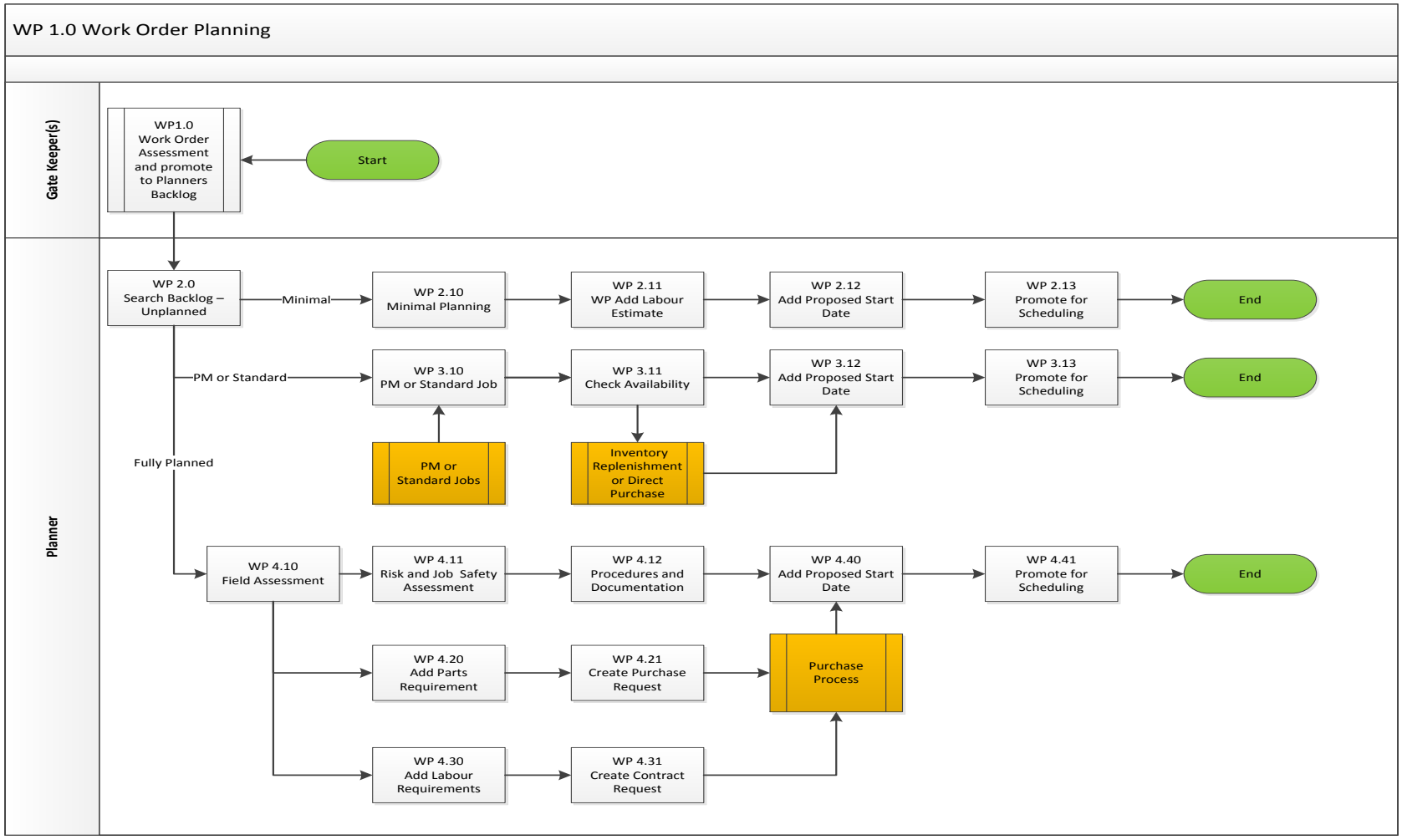
Appendix I – Definitions and Business Rules

<< Add any agree upon business rules or definition associated to the business processes. >>

Business Process

Work Order Planning

The following sample business process provides only the first level of detail Information on the groups or individual positions, their associated tasks (steps) in the process and high level descriptions for each step.



Role	Step ID	Step Title	Step Description
Gate Keeper	1.00	Work Order Assessment	Gate Keeper(s) which can be made up from a combination of Maintenance, Operations and Engineering are to assess the validity of new work. The accuracy and the completeness of these jobs are to be verified at this time. Priority, Shutdown requirements, proper equipment, coding and accounting will be completed before moving on to the planning stage. Full description or scope definition as well the first cut Planned Complete date to assist the planner in scope and priority. Gate Keepers can also reject or assess work as break in. – bypassing Planning Stages
Planner – Minimal Planning	2.00	Backlog Unplanned	The Planner Position will search the open work order to select which jobs are to be planned first (see prioritization / criticality document). The Planner will then decide which level of planning is appropriate for these work orders. • Minimum – Matching the agreed to parameters. • PM or Standard Jobs – these jobs are fully scoped jobs • Full Plan Required – New jobs that have not been planned before or corrective actions that need full assessment
	2.10	Minimal Planning	These jobs are simple 1 to 4 hour jobs that require no specialty tools, or resources, and have standard consumable stores or shop parts. Standard Procedures and Safety Assessment minimal effort.
	2.11	Labour Estimate	Every work order or job requires an estimate for labour. Minimal Planned jobs consist of simple one task labour requirement that can be managed by normal complement of crew.
	2.12	Assign Start Date	Planners after scoping the job will assign the proposed start date as to meet the planned complete date or can be affected by the Annual or Long Term Plan. This information will be used to communicate the requirement to the Scheduler. The Scheduler and area supervisors will assess the validity of these dates and will adjust these accordingly when establishing the upcoming schedule.
	2.13	Promote for Scheduler	Usually a step or status that the Planner will promote jobs to.

Role	Step ID	Step Title	Step Description
Planner – PM or Standard Jobs	3.10	PM or Standard Jobs	These are agreed upon Pre-planned jobs, the planner at this time has little to do with the formulation or scoping of these jobs. The main task for the planner would be to assess the completeness of these jobs before promoting to the scheduler. All documentation, Procedures, and Job Safety Assessment forms are attached or identified. It can also be a good time to look at the historical correctness of these jobs, for the continuous improvement of the current PM system. ** It is usual to have a policy in place to assess the accuracy of the plans attached to these generated jobs. PM formulation may not be part of your Planning function if so a procedure for the continuous improvement and feedback is required.*
	3.11	Check Availability	These fully scoped jobs may not be ready for Scheduling due to parts availability or the requirement of outside services. The planner and inventory policies will determine if this will be satisfied by inventory replenishment, or if creating direct purchase request are required. Timing and confirmation dates for these purchase requests are important for defining the start date of the work order. **Follow the Site or Company policy.*
	3.12	Propose Start Date	Planners after scoping the job will assign the proposed start date as to meet the planned complete date or to be completed in the outage or campaign windows established in the Annual or Long Term Plan. This information will be used to communicate the requirement to the Scheduler. The Scheduler and area supervisors will assess the validity of these dates and will adjust these accordingly when establishing the upcoming schedule.
	3.13	Promote to Scheduler	Usually a step or status to which the Planner will promote work orders.
Planner – Fully Planned Required	4.10	Field Assessment	For non-regular repairs that have had no historical plan, a field assessment can be a critical step in the planning procedure. The planner may require assistance from other Maintenance personnel when *area or conditions are remote*, or Engineering if changes or additional “as built” or “red line markups” are required. It is at this time the Planner

Role	Step ID	Step Title	Step Description
			may change the work requirements and scope of the job. It will be up to the planner to communicate the findings from the Field Assessment if there is job scope creep. These jobs may require an additional approval from management, or require assessment from Engineering, and/ or the Capital Managers. It is important that these jobs are fully scoped. Tool requirements or rental requirements should also be assessed during field assessment.
Planner – Fully Planned Required	4.11	Risk and Job Safety Assessment/Analysis	Depending on the scope of the job, a first-cut safety analysis (Task Based Risk Assessment (TBRA) or Job Safety Analysis (JSA)) may be required or created for the intent of the job and recorded against the job to be used at time of scheduling and/or execution.
	4.12	Procedures and Documentation	It is up to the planner to identify the required procedures, and additional documentation that are needed for the completion of the job. i.e. Drawings, OEM manuals, SOP's, and/or Engineering requirements (Standards or Directives).
	4.20	Parts Requirements	Identify standard warehouse parts and availability as well as direct buy requirements. **Tool requirements may be under parts.*
	4.21	Create Purchase Request	Under the site buying policy, identify and create the non- stock parts requirement for purchase. Availability and delivery need to be understood to establish a reasonable start date.
	4.30	Labour Requirements	Assess the steps required for the completion of the job, this should include all affected trade groups, operational, and contract personnel.
	4.31	Contract Request	Blanket orders should be considered prior to creating a new request for services or rental agreements. Create appropriate Service or Rental request, proposed start date and availability is required for a first cut Start Date.
	4.40	Assign Start Date	Planners after scoping the job will assign the proposed start date as to meet the planned complete date or can be affected by the Annual or Long Term Plan. This information will be used to communicate the requirement to the Scheduler. The Scheduler and area supervisors will assess the validity of these dates and will adjust

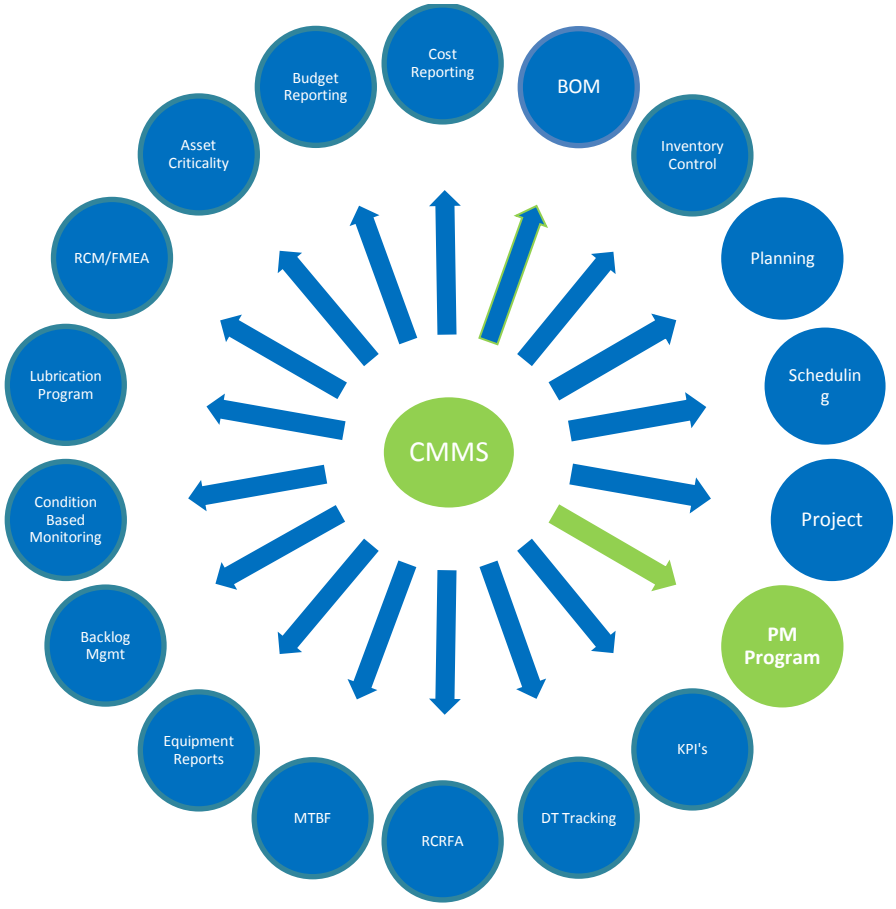
Role	Step ID	Step Title	Step Description
			these accordingly when establishing the upcoming schedule.
	4.41	Promote to Scheduler	Usually a step or status to which the Planner will promote Work Orders.

Corporate Business System - ERP Assessment

Business Process Document - Asset Management

Preventive Maintenance PAAR Level 1

August 14th/2018



Version	Date	Description of Revision	Author
R1	2016-12-20	Updated after process review	S. McCarthy
R2	2018-08-14	Updated after CAM Champions Review	S. McCarthy

Contents

Purpose

The intent of this document is to define the PAAR Level 1 requirements for the PM Procedure.

Preventive Maintenance (PM) is planned and scheduled maintenance performed at an established interval or frequency.

Preventive Maintenance (PM) is predetermined, regularly scheduled maintenance that is designed to prevent equipment failures. The interval is usually run hours, miles/km traveled or calendar days.

Preventive Maintenance does not require condition based monitoring, but includes condition monitoring techniques like vibration analysis and oil analysis.

Critical equipment requires a cross functional team from maintenance and operations to analyze data from equipment history, personal experience and manufacturer data to determine the technically feasible steps to economically reduce failures. These steps can then be formulated into a PM for input in the CMMS which PM includes resources, job steps, frequency and required materials. Updating the maintenance strategy is a continual improvement process throughout the equipment life cycle.

Advantages of PMs

Planning is the biggest advantage of Preventive Maintenance over less complex strategies. Unplanned, reactive maintenance has many overhead costs that can be avoided during the planning process. The cost of unplanned maintenance include lost production, higher costs for parts and shipping, as well as time lost responding to emergencies and diagnosing faults while equipment is not working. Unplanned maintenance typically costs three to nine times more than planned maintenance[1]. When maintenance is planned, these costs can be reduced. Equipment can be shut down to coincide with production downtime. Prior to the shutdown, any required parts, supplies and personnel can be gathered to minimize both equipment downtime and labour hours. These measures decrease the total cost of the necessary maintenance.

Effectively planned, scheduled and completed PMs will improve system reliability, decrease operational cost and unplanned system downtime and provide a safer workplace for our crews. Also, service records will be maintained and available for future reference to allow Asset Management to make informed decisions on refurbishment or replacement of these assets.

When PMs are planned in advance the labour and material plans do not have to be re-written each time the service is called to create a work order. This both saves planning time and provides a platform to continually improve the PM plans and data.

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[1] The Cost of Unplanned Maintenance includes the costs of extra equipment downtime, extra Maintainer hours required, emergency materials sourcing and air freight. To add to this, unplanned jobs are inherently less safe than planned jobs.

PM Services are pre-approved and pre-scheduled. PM Work Orders do not have to be handled by so many people prior to execution. PM Work Orders by-pass the Gatekeepers and many of them may bypass the Planners once they are created and planned.

Disadvantages

Unlike Reactive Maintenance, Preventive Maintenance always requires maintenance planning. This requires an investment in Planner time and resources not required with less complex maintenance strategies.

It is important that PM routines be both technically feasible (i.e. you have the technology to perform the task and assess the results) and economical (i.e. doing the task is cheaper than the consequences of failure). Commonly, Preventive Maintenance frequency is incorrect. Unless, and until the PM frequencies are optimized, too much or too little Preventive Maintenance will occur. Repair activities generated from PM inspections should be monitored to measure PM efficiency.

In order to measure PM cost and the consequences of failure, both the real cost of a maintenance person-hour and the cost of unavailability must be known. Both of these factors must be kept up-to-date.

Business Process – PM

The Preventive Maintenance programs in JDE E1 generate work orders, checklists and procedures on a predetermined schedule. PM cycle is reset when the order is moved to Complete Status and data entered. Overdue PM's can be tracked by percentage due. PM's over a defined threshold percent greater than 100% due should be considered overdue. PM's completed at a defined threshold percent less than 100% due should be considered to have been completed too early.

Completion of PMs in a timely fashion is a goal that must be supported by all parties, especially Operations and Maintenance groups. Maintenance groups must have appropriate labour resources available and Operations groups must make equipment available. The risk of not completing the work must be balanced against the long and short term needs of the organization. PM late non-conformances may be due to failure to release equipment resulting from aversion to the risk of running without backup or to the risk of transferring load from running to stand-by equipment.[2] It is essential to operate the equipment in the way it is designed, and in accordance with its agreed operating context[3]. One of the more important elements in defining the operating context or equipment is redundancy.

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[2] Revision 2: Aversion to risk of making equipment available for maintenance points to the need to consider (1) more condition monitoring approaches for running equipment; (2) Different maintenance tactics for running and standby equipment; and (3) accepting that if one cannot transfer load reliably between running and standby equipment, then you don't have a standby.

[3] Operational context: The current condition, environment, and culture in which you operate a piece of equipment.

Redundancy affects the design of the appropriate maintenance tactics for the equipment. This means that if the equipment was designed with a standby capability, and the current operating context confirms this, then any type of work involving a shutdown of the equipment may be scheduled at any time. Other operational and environmental considerations may dictate actual completion date. Scheduling PMs may also include consideration of the most effective use of time and resources. Often travel or cancelled outages due to operational needs will hinder a crews ability to complete a PM in a timely manner and may result in added cost and effort.[4]

All PM's set up should have BOM attached, regardless of whether or not the task requires parts. The BOM attached to the model work order contains the routing instructions (Job steps and estimates - "THE PLAN") and the parts requirements, both direct purchased and inventory. PM work orders could be generated at a Status "Waiting to schedule" and if they do not require a reduced load (i.e. a unit outage), purchased materials or outside services they should bypass the planning stage. The routing instructions from the BOM automatically populate the new PM work order. BOMs aid in the warehouse in preparing materials in advance for a scheduled PM in timely manner and ensure that the estimated hours and crews are identified for the weekly schedule.[5]

The lack of availability of long lead time materials, where those materials are required for PMs, can cause significant delays in competing PMs. If this is a concern, and to avoid undue increases in warehouse inventory holdings, the following options should be evaluated in terms of their financial risk:

- The PM Services can be configured to create work orders at a Maintenance Service Percent Due low enough to ensure that materials are committed and received in advance of the need. In this scenario quantities of the materials are configured as stock items but not normally held in inventory but are ordered through inventory replenishment when demand is created. This may be appropriate when the usage frequency is a multiple of the replenishment duration.
- The items may be made into stock items. This may be appropriate when the frequency of demand for the material is not much greater than the time to replenish inventory. Stores management may adopt strategies to reduce the replenishment time, such as vendor pricing supply agreements.[6]

If while performing a PM task, it is necessary to perform repair maintenance, the Technician should write a separate work request in all cases. He should make the correction if it takes less than ½ hour; above that, others must be informed and make the decision regarding how to handle the defect. This limit is necessary because without it, the PM Technician can spend too much time correcting and not

[4] Revision 2: This paragraph added
[5] Revision 2: Revised sentence on the usefulness of PM BOMs
[6] Revision 2: Added this paragraph on materials planning and integration with Stores processes.

enough time performing PM activities. If a Corrective Work Order is not created, we will have inaccurate failure history and costs of PM.

PM work orders should include work procedures with details, like tolerances and methods. Without detail, PM depends on the Maintenance Technician's memory and personal skills. His/her approach may or may not be correct. Even if it is correct, it could get lost if the person leaves or is reassigned

A PM schedule can be created for any piece of equipment for which you require recurring maintenance tasks. On each PM schedule, indicate each service type that should be associated with that equipment. Also specify the rules governing how and when each service type is performed.

Service types can be used:

- For regularly scheduled maintenance
- For unscheduled maintenance tasks (such as cleanings on an as-needed basis or repairs at the point of equipment failure.
- To signal warranty service
- For other planning events not necessarily associated with Preventive maintenance tasks (such as license renewals and re-certifications)
- For investigations Orders from Condition Alerts

PM Work Orders may be generated by several methods.

- Generating by Batch Process, both manual and by nightly scheduled event
- Generate Planned Unscheduled Events - Manual
- Generate by Pre-firing or Overriding the Scheduled Event - Manual
- Condition based alerts – both manual or automatic

It is common to set and forget PM routines. The system should be set up to generate most of the PM's for a site at night so that in the morning the jobs will be ready. The ability to create orders at any time is possible but should only be available to a high level user of the PM system. PMs may also be set up to generate on certain days of the week or month in order to make it easier for scheduling.

There are certain types of PM's that can be assigned for manual generation or 'on request' generation. Within E1 these tasks would be considered Planned Unscheduled Events. In this situation, the model job plan is created but is not set up on an interval (there is no PM Trigger or frequency).

There is an ability to override the schedule event and generate scheduled PM on request. This is a necessary requirement, but should only be used by JDE Users with a good working knowledge of the PM system.

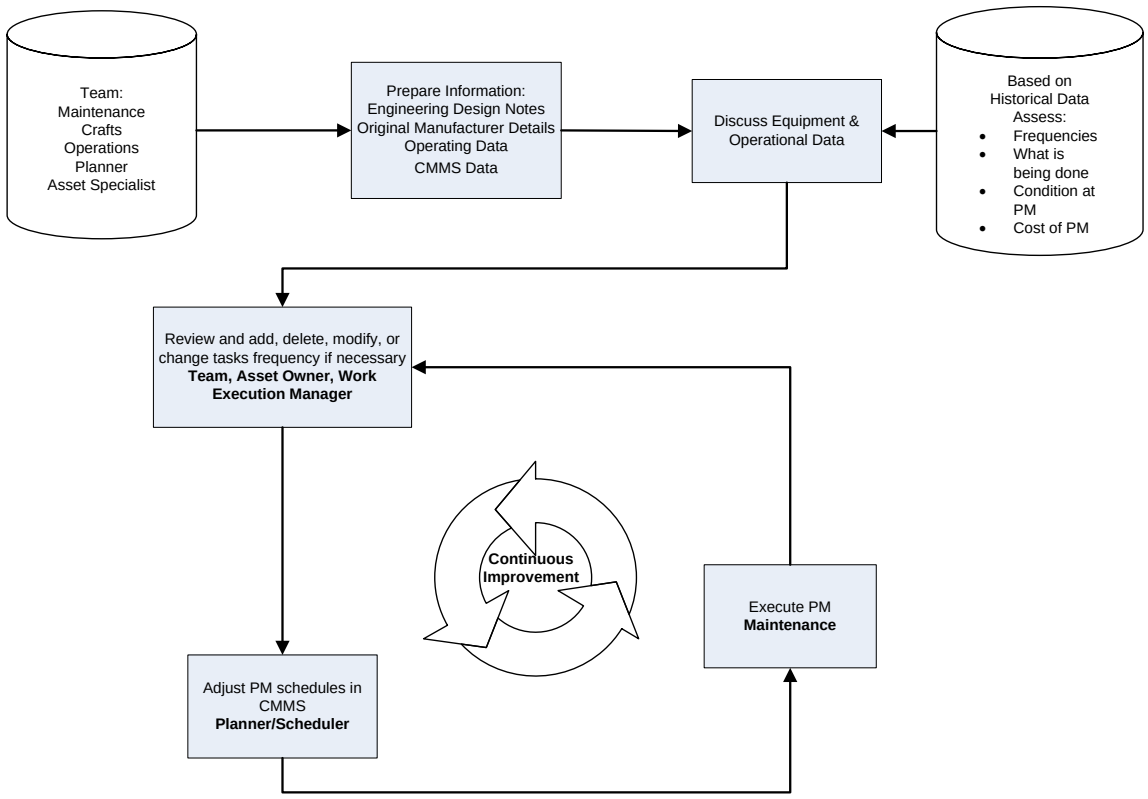
PMs are pre-approved model work plans that have been assessed and accepted as required tasks to maintain the integrity of the equipment to which they have been assigned. A continuous improvement process needs to be in place.

It is important to advance the status of PM Work Orders to 70 as soon as they are completed, and especially so for single cycle PMs. All completed documentation including WO "Actual Work Performed" and check sheets must be completed in a timely fashion.

PM Schedule, task, and check sheet continual improvement should be part of daily activities. Formal reviews of maintenance tactics, using a methodology such as Reliability Centered Maintenance (RCM), should be performed regularly or when the operating context of the assets changes.

All PMs should be reviewed to determine what portions of Preventive Maintenance can be completed on-line as well as outside of the traditional maintenance season window. This can result is short outage times (higher availability) and better utilization of crews and equipment[7].

Continuous Improvement



[7] Revision 2: Three paragraphs added as part of AM Champions review.

PM Metrics

- Does the plant/area have a documented PM / PdM procedure in the standard Nalcor format and aligned with the Nalcor standard in sufficient detail to provide guidance on PM and PdM management requirements, including roles and responsibilities. The procedure is in force and has been effectively communicated.
- There is a plant/area guideline in place for selecting appropriate PM, PdM, CbM, and Operator basic care tasks, including a focus on critical equipment, an understanding and quantification of the cost of maintenance and the consequences of equipment failure.
- There is a plant/area guideline in place defining approval for new tasks that recur at a defined frequency (days and meter based PMs).
- There is a plant/area guideline in place defining the requirements and approvals necessary to defer or cancel tasks that recur at a defined frequency (days and meter based PMs), and especially those tasks associated with Critical Equipment.
- PM Compliance, as measured from PM Backlog.
- Number of Cancelled PM Services
- Corrective work orders created as a result of PM Inspections.
- Survey of completed PM WO's requiring check sheets with completed check sheet data attached, where the data is useful in future work or for asset history.[8]
- % PM Jobs with standard Labour plans and standard Labour & Material Plans
- Number of PM Check Sheets sourced from binders, and not attached to PM Model WOs[9]

Approvals

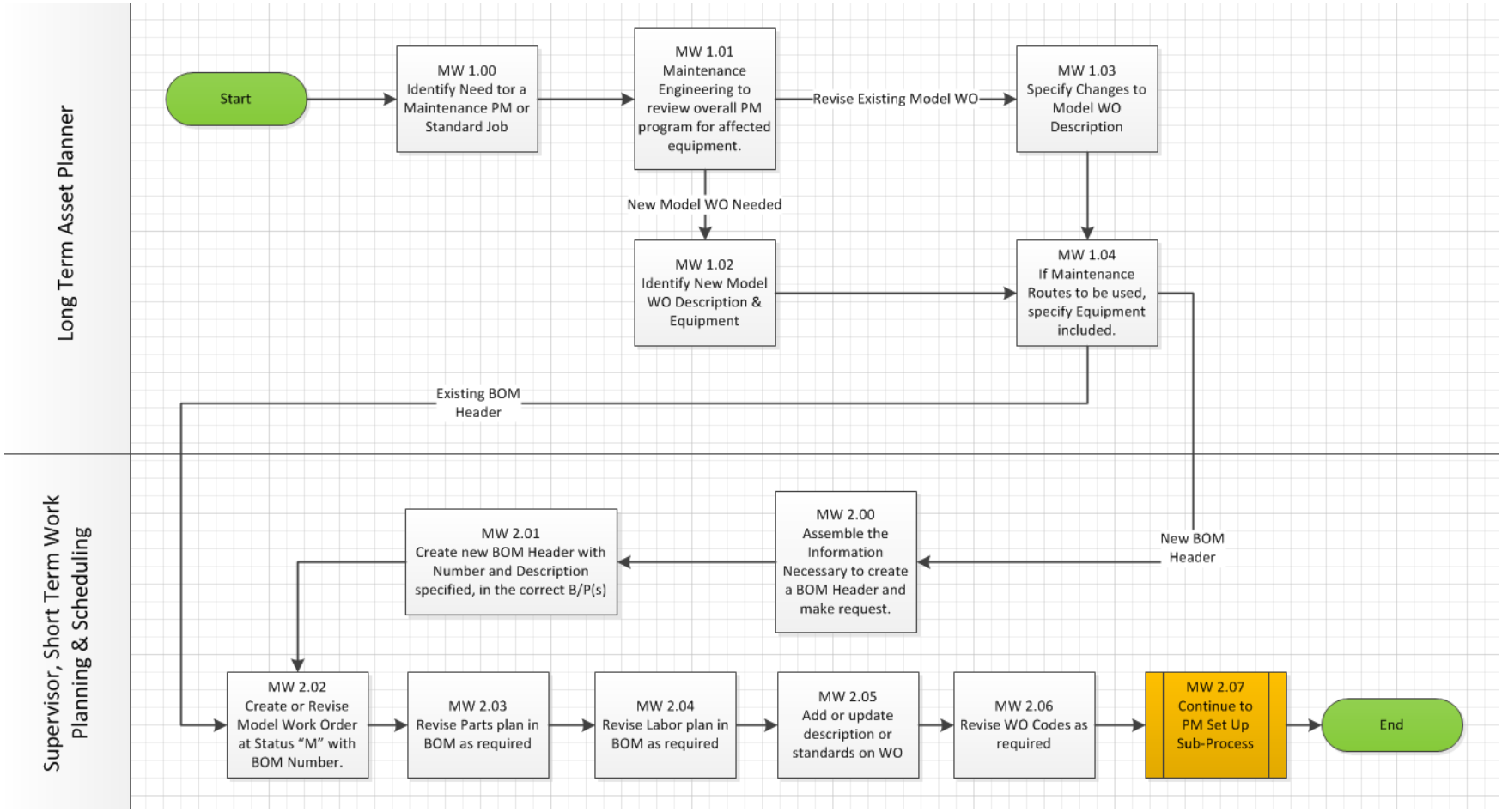
	(name)	(signature)	(yyyy/mm/dd)
	(name)	(signature)	(yyyy/mm/dd)

Appendix I – Definitions and Business Rules

1. A Work Order is not necessarily a PM Work Order because it is generated from the PM Module in the CMMS. Technically, any Work Order type may be generated from the PM module.

[8] Revision 2: Added check sheet availability through JDE as a metric as a result of AM Champions review. Note that there may be cases where the attachments are on the asset record instead of on the WO. If so, supplemental data should be used, since the asset supplemental data is also available on equipment records.
[9] Revision 2: Added check sheets attached to the model work orders as a result of AM Champions review

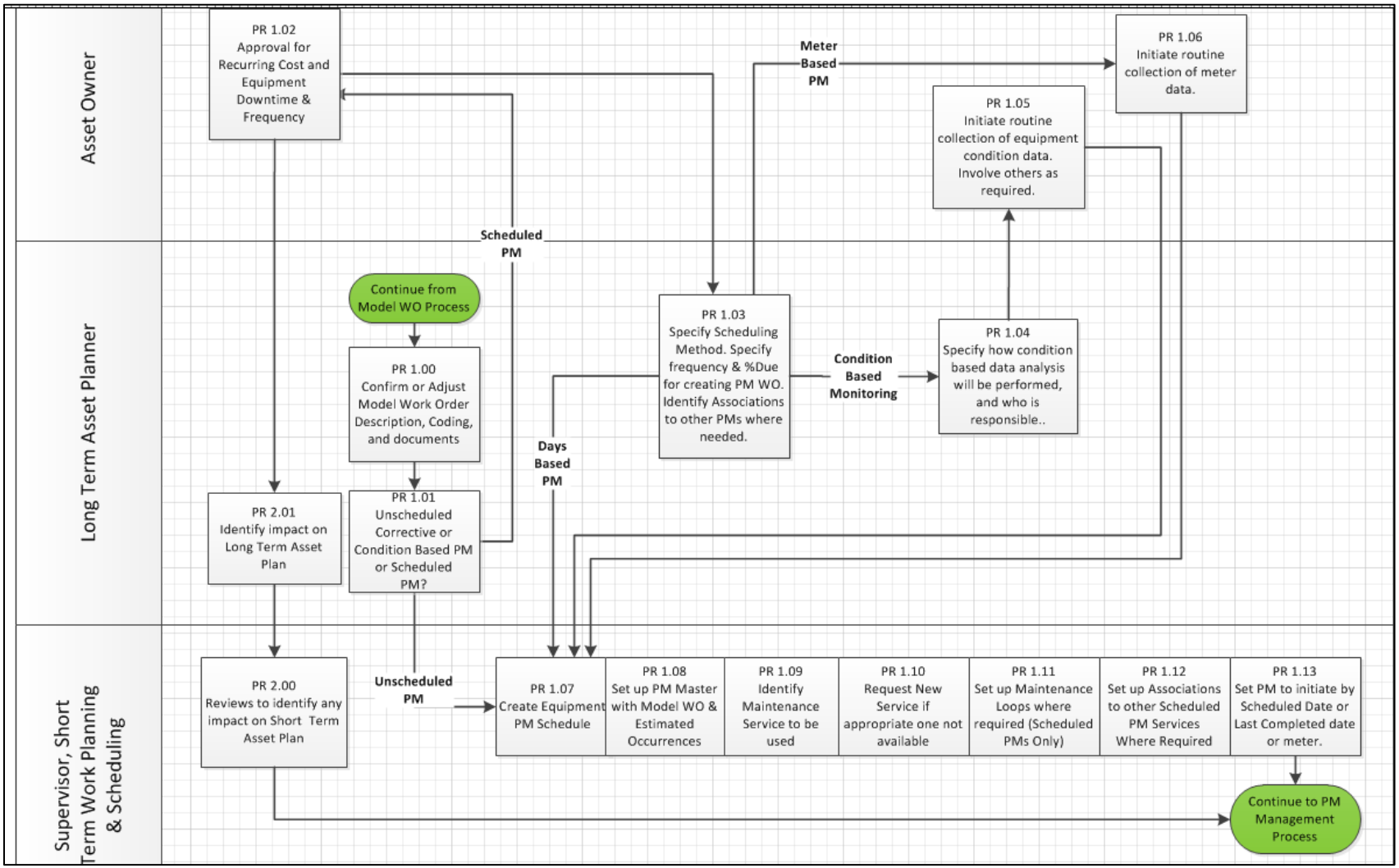
Business Process - Model Work



Role	Step ID	Step Title	Step Description
Long Term Asset Planning	MW 1.00	Identify Need tor a Maintenance PM or Standard Job	Identifying the need to create or change Model work orders can happen through: • New Assets/Equipment bought or installed • OEM Identified – new requirements and updates. • Historical Equipment failure Assessment. • Work Order Planners/Scheduler assessment – through Continuous Improvement
	MW 1.01	Maintenance Engineering to review overall PM program for affected equipment.	Normally there are two reasons for an Equipment PM review. • New Assets are being added through system change or Capital Projects • Equipment identified for assessment or review due to increasing failures, breakdown by several equipment measurements • Increasing Failures to certain Equipment Types • Changes to Regulatory requirements
	MW 1.02	Identify New Model WO Description & Equipment	Where new PM or duties have been added or expanded to include these equipment.
	MW 1.03	Specify Changes to Model WO Description	Where expected results and not matching Manufactures Recommendations.
	MW 1.04	If Maintenance Routes to be used, specify Equipment included.	If standard BOM's are used for types of services or commonly used routes

Short Term Planner	MW 2.00	Assemble the Information Necessary to create a BOM Header and make request.	Where new BOM are required follow BOM standard Process
	MW 2.01	Create new BOM Header with Number and Description specified, in the correct B/P(s)	Where new BOM are required follow BOM standard Process
	MW 2.02	Create or Revise Model Work Order at Status “M” with BOM Number.	Add or change BOM number to existing Model work order or create model from new.
	MW 2.03	Revise Parts plan in BOM as required	Easily accessed through Model Work Order
	MW 2.04	Revise Labor plan in BOM as required	Easily accessed through Model Work Order
	MW 2.05	Add or update description or standards on WO	
	MW 2.06	Revise WO Codes as required	Make sure all appropriate items have been added to the parts list
	MW 2.07	Continue to PM Set Up Sub-Process	Preventive Maintenance Routes

Business Process - Preventive Maintenance Routines

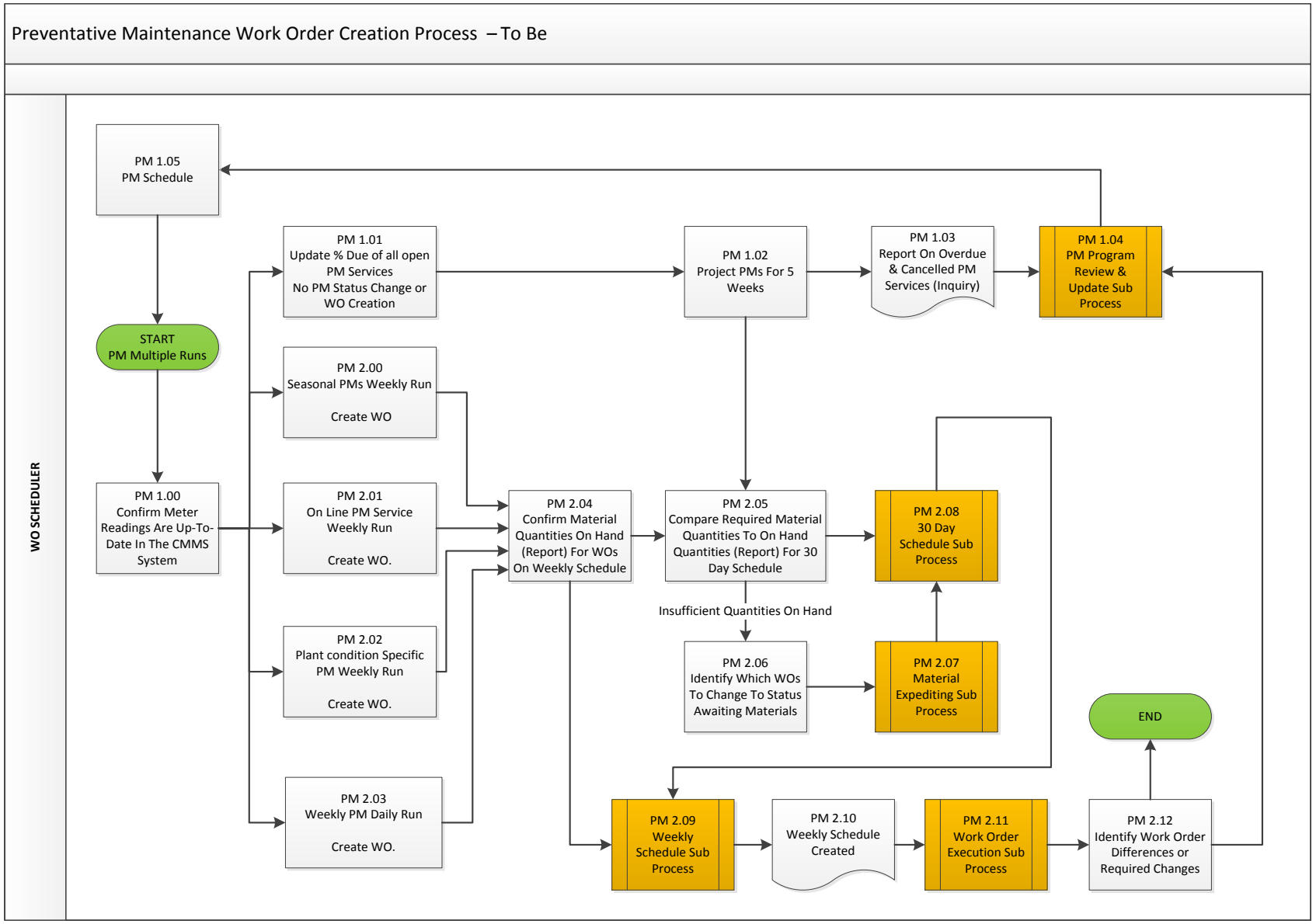


Role	Step ID	Step Title	Step Description
Long Term Asset Planning	PR 1.00	Confirm or Adjust Model Work Order Description, Coding, and documents	
	PR 1.01	Unscheduled Corrective or Condition Based PM or Scheduled PM?	
Asset Owner	PR 1.02	Approval for Recurring Cost and Equipment Downtime & Frequency	For PM that can have large monetary value or requires system down or interruption, these types can affect both Budget and have production impact both the Short and Long term Asset Planning groups should be contacted. – Step 2.00
Long Term Asset Planner	PR 1.03	Specify Scheduling Method. Specify frequency & %Due for creating PM WO. Identify Associations to other PMs where needed.	Where data collection is required for Equipment Conditions even though these can be feeding into a condition monitoring, the acts of collection of these data are not considered a Predictive Activity. It is the result and there assessment that can generate the PDM Work Order. Capturing Meters is strictly a PM route activity. If Meter reading – move to PR 1.06
	PR 1.04	Specify how condition based data analysis will be performed, and who is responsible...	As stated, the Who, What and With (device, or method) questions need to be answered before setting both the model work order as well cycle times in which to take these measurements.

Role	Step ID	Step Title	Step Description
Asset Owner	PR 1.05	Initiate routine collection of equipment condition data. Involve others as required.	Identify both the Responsible parties as well as collection cycle
	PR 1.06	Initiate routine collection of meter data.	Identify both the Responsible parties as well as collection cycle
Supervisor, Short Term Work Planning & Scheduling	PR 1.07	Create Equipment PM Schedule	
	PR 1.08	Set up PM Master with Model WO & Estimated Occurrences	
	PR 1.09	Identify Maintenance Service to be used	It is important to note that depending on the type of PM Service types • Calendar • Meter • Condition It is important to select the correct service type
	PR 1.10	Request New Service if one not available	All New Service types will have to be set up in the Maintenance rules correctly before using. Forward to Planner for set up verification.
	PR 1.11	Set up Maintenance Loops where required (Scheduled	

Role	Step ID	Step Title	Step Description
		PMs Only)	
	PR 1.12	Set up Associations to other Scheduled PM Services Where Required	
	PR 1.13	Set PM to initiate by Scheduled Date or Last Completed date or meter.	
Supervisor, Short Term Work Planning & Scheduling	PR 2.00	Reviews to identify any impact on Short Term Asset Plan	Identify how these new PM requirements, affect both budget, and its production impact.
Long Term Asset Planner	PR 2.01	Identify impact on Long Term Asset Plan	Identify how these new PM requirements, affect both budget, and its production impact.

Business Process - Preventive Maintenance Work Order



Role	Step ID	Step Title	Step Description
WO Scheduler Statistical update and PM Assessment	PM 1.00	Confirm Meter Readings Are Up-To-Date In The CMMS System	It is important that where sites are using Meter triggered PM's that there is a coordination that these readings are completed before the batch run of the PM generation program
	PM 1.01	Update % Due of all open PM Services No PM Status Change or WO Creation	This first Batch run is to keep the PM system Current with % due and does not update or create work orders. This will be set up to run automatically during off hours
	PM 1.02	Project PMs For 5 Weeks	Once updated the WO Scheduler can run the PM Projections out for a minimum of 5 weeks. This will give the Scheduler the ability to see the upcoming events, as well as the material demands the system is forecasting. – go to step PM 2.05
	PM 1.03	Report On Overdue & Cancelled PM Services (Inquiry)	This standard report can assist with the Health of the PM system and give insight for what PM's may require attention or create a requirement for change of PM.
	PM 1.04	PM Program Review & Update Sub Process	This continuous PM Improvement need to be managed by a combination of personnel • Asset Specialists • Work Execution Managers • Operations and/or Asset Owners The time frame for this is site dependent, and should be triggered from the Prior health that the Overdue/Cancelled report will give you
	PM 1.05	PM Schedule	Update PM Schedule to the approved changes required. – See PM Routes
	PM 2.09 Weekly Schedule Sub Process	Seasonal PMs Weekly Run - Create WO	Site specialist or Schedulers should be responsible for the Batch running of this process.

Role	Step ID	Step Title	Step Description
	PM 2.01	On Line PM Service Weekly Run - Create WO	Site specialist or Schedulers should be responsible for the Batch running of this process.
	PM 2.02	Plant condition Specific PM Weekly Run - Create WO	Site specialist or Schedulers should be responsible for the Batch running of this process.
	PM 2.03	Weekly PM Daily Run - Create WO	This will be set up to run automatically during off hours
	PM 2.04	Confirm Material Quantities On Hand (Report) For WOs On Weekly Schedule	Identify the required parts for the generated work orders and their availability.
	PM 2.05	Compare Required Material Quantities To On Hand Quantities (Report) For 30 Day Schedule	Working with Supply Chain – assess the missing parts required for the upcoming and forecasted PM's
	PM 2.06	Identify Which WOs To Change To Status Awaiting Materials	Where Supply Chain cannot satisfy parts requirement and change status to Awaiting Material
	PM 2.07	Material Expediting Sub Process	See Material Expediting
	PM 2.08	30 Day Schedule Sub Process	See Scheduling Process
	PM 2.09	Weekly Schedule Sub Process	See Scheduling Process

Role	Step ID	Step Title	Step Description
	PM 2.10	Weekly Schedule Created	Print Weekly work orders for Execution
	PM 2.11	Work Order Execution Sub Process	See Work Order Execution
	PM 2.12	Identify Work Order Differences or Required Changes	For continuous improvement monitor the Planned vs. Actual

Corporate Business System - ERP Assessment

Business Process Document

Work Order Prioritization

Asset Management

August 10th/2018

Version	Date	Description of Revision	Author
R1	2016-12-20	Updated after process review	S. McCarthy
R2	2018-08-10	Updated after AM Champions Review	S. McCarthy

Contents

Purpose

The Work Order Prioritization Procedure ensures the highest value work is completed in the proper sequence with available resources and ensures that resources are directed to maintenance work based on the work's true urgency, including minimizing maintenance and forced outages and customer service interruptions.

In order to accomplish this, the work must be planned and scheduled in the appropriate sequence. The Work Order Prioritization Procedure must ensure that the relative impacts to Safety, the Environment, and Production are taken into account along with the probability when assessing the priority of any Work Order under consideration.

Appropriate Operations and Maintenance personnel, and Asset Specialists, must have a complete understanding of prioritization and follow the established procedure.

Area and Plant Managers must ensure that the Work Order Prioritization process is in place and followed, and that the appropriate personnel are trained in the procedure.

Business Process - Prioritizing Work Orders

Gate Keeper

The Gate Keeper should be one person or a group whose primary responsibility is to represent the interests of all stakeholder groups while coding and promoting new work (good work) to be assessed by Planning. A Gate Keeper committee would have representatives from Operation, Maintenance and where needed Asset Specialists and Engineering. Whether the Gate Keeper were a single individual or a group, then the needs of all stake holder groups would have to be fairly represented and the member(s) would have detailed technical knowledge of the equipment and its failure modes. This position allows the Short Term Planning and Scheduling personnel to focus actively on planning (at the appropriate time[1]) fully scoped work orders and coordinating the efforts of the entire maintenance crew.

All requests for the use of Maintenance Services shall be made using a Work Order in the CMMS. Should the work scope be defined as "emergency", the work order must be created as soon as possible, and no later than the end of the shift, or overtime call-out event.

The responsibilities for the Gatekeepers should include the following when reviewing work order:

- ***Accept/Approve or reject New Work Priority***

[1] Revision 2: Added text to highlight that Planners should plan jobs in time, but not too early, and in the appropriate order.

- ***Eliminate Duplication***
- ***Identify requirement against long term plan***
- ***Clarify the Description – Clarify the problem, and extent of what the plan should include (repair, replace..)***
- ***Add or update coding – failure, reporting ….. required to support ongoing assessments***
- ***Accurately identify the Equipment***
- ***Confirm and if necessary update the Business Unit or Project (Ops vs. Capital)***
- ***Enter the Planned Start Date (rough cut requirement to aid in the organization of planning activities)***
- ***Enter the Requested Finish Date (based on plant/customer needs and equipment condition)***
- ***Promote to Planning***
- ***Approve as Break in [2]Work if appropriate – Emergencies or Break in Work bypass the Planning stage and goes directly to active work.***
- ***Identify the level of Planning required (Minimal or full detail)***

Additional related activities for the Gate Keeper role:

- ***Receive feedback from planning – where job scope creep occurs or planning process reveals that the work cannot be executed prior to the Planned Complete Date***
- ***Receive feedback from Scheduling – when complete dates are going to be missed for a reprioritization.***
- ***Provide feedback to Work Order Originators regarding quality and completeness of Work Requests.***

Proactive vs. Reactive Work

Proactive Maintenance is the combination of Operator performed maintenance, preventive maintenance, and condition based monitoring activities conducted to prevent, eliminate, or delay failures; to detect failures, or to reduce the consequences of the event before failure occurs, and also the work activities identified from them. In general, a proactive action is one that is planned, scheduled and executed before a break-down occurs, and includes maintenance prevention activities.

Proactive Maintenance processes include several sub-processes, including identification of critical equipment, failure analysis, basic operator care and Reliability Centered Maintenance (RCM).

All Scheduled jobs are not Proactive, and all Repair jobs are not reactive.

[2] A Break-In is any work that is performed during the weekly scheduling period that was not on the schedule when it was set in the prior week.

	Identified Failure Mode?	Proactive?	Corrective?	Pre-planning possible?	Is there Advance Warning?
Predictive Mtce.	Y	Y	N	Y	Y
Predicted Mtce.	Y	Y	Y	Y	Y
Preventive Mtce.	Y	Y	N	Y	Y
Detective Mtce.	Y	Y	N	Y	Y
Detected Mtce.	Y	Y	Y	Y	N
No Scheduled Mtce.	Y	N	Y	Y	N
Emergency / Urgent	Y	N	Y	?	N

Figure 1 - Proactive vs. Reactive Tasks. Jobs with no advance warning are reactive[3].

The question of whether a Corrective job is reactive is usually resolved as follows:

- ***If it is an emergency, then the corrective job is Reactive.***
- ***If the equipment is in a functionally failed state, then the corrective job is Reactive.***
- ***Regardless of whether the defined maintenance tactic is "run-to-failure", if the equipment is in a functionally failed state, then the corrective job is Reactive.***
- ***If the equipment has not failed functionally at the point when the repair is actually performed, then the corrective job is Proactive.***

The vision for a Proactive culture includes the following achievements:

- ***Accurate Backlog of Work***
- ***No Emergency Work***
- ***High Schedule Compliance***
- ***Paperless Environment***
- ***Reasonable Overtime***
- ***Partnership between Production and Maintenance***
- ***Operator Care Program (Operator Routine Duties)***
- ***Exceed Environmental And Safety Regulations***
- ***Increase Equipment Availability And Reliability***
- ***Decrease Maintenance Costs per Unit of Production (or replacement asset value)***
- ***Integrate with Operations & Engineering***

[3] Revision 2: Changed Figure bottom left hand cell from "Emergency/Reactive" to "Emergency/Urgent"

Minimum Requirements for Work Order Prioritization

- ***Develop a Work Order Prioritization matrix to balance risk [probability (urgency) and consequence[4] (importance)] for reactive maintenance.***
    - ***Consequences shall include those for Safety, the Environment, Cost and Production Loss / Customer Service Interruption.***
    - ***Suggested formats are included in the appendices***
    - ***Threshold levels for Consequence (Importance) should be defined locally.***
- ***Develop a method for prioritization of Project (Improvement) Work involving changes to equipment and/or process on the basis of avoided cost.***
- ***Prioritize Proactive Corrective Work Orders based on assessed equipment condition.***
- ***Prioritize Preventive & Predictive Maintenance tasks to get them completed within ten percent either way of their defined frequency.***
- ***Threshold values for Safety, the Environment, and Production Loss / Customer Service Interruption shall be defined clearly enough to be used as a guide to support the process.***
- ***The Work Order Priority resolved from the Work Order Prioritization matrix shall result in an assigned Work Order Requested Finish date.***
    - ***The Requested Finish Date for Proactive Maintenance shall take the timeframes of the P-F[5] curve into account.***
    - ***There should be no Work Orders in backlog with Requested Finish Dates in the past.***
    - ***The Work Order "Requested Finish Date" represents an agreement between Operations or other stakeholder and the Maintenance group that the work will be completed by that date.***
        - ***The Work Order Requested Finish Date may be adjusted as often as required because of new conditions (i.e. not deteriorating as quickly as expected; backup equipment condition deteriorating) or an improved understanding of the failure mode.***
        - ***"Requested Finish" dates for corrective work orders[6] will not be set based on availability of equipment or resources.***
        - ***Changes to the Work Order "Requested Finish Date" can only be done by the Gate Keeper.***
    - ***The Work Order "Planned Start Date" is Not used for Work Order Prioritization, but for Scheduling.***
        - ***The "Planned Start Date" should be an appropriate number of days before the "Complete By" Date.***

[4] For reactive maintenance, the consequences are those that will occur if the breakdown is not repaired. Consequence should not be used alone, but only with probability.
[5] The P-F Curve as used here refers to the time from the discovery of the Potential Failure (P) to the expected time of the Functional Failure (F). The Functional Failure is defined as the point at which the equipment no longer does what Nalcor wants it to do. (i.e. if a pump needs to transfer 30 USGPM from a reservoir to a tank, when it can only move 29 USGPM it has functionally failed; it is not design capacity but desired capacity).
[6] Revision 2: Corrective Work Order Requested Finish Dates should not consider resource availability. The Planned Start Date is used for scheduling.

  - ***The "Planned Start Date" reflects equipment and resource availability, not priority.***
  - ***The "rough cut" Planned Start Date is to be used by the Planners to schedule their activities.***
  - ***The Planned Start Date may be adjusted by the Planners to reflect materials, equipment, or resource availability, as long as it remains a sufficient number of days prior to the Requested Finish Date.***
- ***The Work Order Prioritization process shall occur only after any emergency risk mitigation activities are completed and reviewed (i.e. hang a tarpaulin, then prioritize the roof repair).***
- ***The Work Order Prioritization matrix is approved by Plant or Area Manager(s).***
- ***Immediate Health, Environment, and Safety problems and Major Production Losses should receive the highest priority, and result in schedule break-ins.***
- ***Controlled Health, Environment, and Safety problems and Minor Production Losses should receive a lesser priority, but may result in a schedule break-in.***
- ***Equipment criticality should be taken into account, but not by itself. The failure mode, system design, and the condition of backup equipment should also be considered. No formula can automatically take these factors into account to assign a work order priority.***
- ***Consideration should be given as to how to prioritize shutdown jobs that might be scheduled earlier as Opportunity Maintenance[7].***
- ***Consideration should be given as to how Customer Service Work Orders should be prioritized.***
- ***Preventive Maintenance, Predictive Maintenance, and Corrective Maintenance should be performed as scheduled unless break-in work prevents the work being done.***
- ***The Plant or Area Manager should ensure that the appropriate personnel are trained on the Work Order Prioritization process.***

Metrics that shall be used as KPI's for the Prioritization function

- ***Percent Break-In Work***
- ***Percent Proactive Work***
- ***Percent Emergency Work***

Validation of the Prioritization Process

- ***Confirm that the Prioritization matrix exists and is available for use.***
- ***Confirm that Gate Keepers daily review and prioritize new work orders and re-assess work orders whose Requested Finish Dates are approaching.***
- ***An assessment should be made of the level of awareness of the Work Order Prioritization procedure through interviews with first and second line Maintenance and Operations Supervision and observation of gate keepers.***
- ***Work Orders should be sampled to assess the level of adherence.***

[7] Opportunity Maintenance usually refers to work that required a shut down or de-rated plant or system condition not usually available, which work is performed when other circumstances, like a forced outage, make the performance of the work possible ahead of a Scheduled Outage.

- ***Training records should be reviewed.***
- ***The amount of reactive work should decline over time to a more acceptable level.***
- ***There should be a local process, approved by area management, defining in what ways this process is implemented across the local area, including scope and personnel or position assignments.***[8]

Approvals

	(name)	(signature)	(yyyy/mm/dd)
	(name)	(signature)	(yyyy/mm/dd)

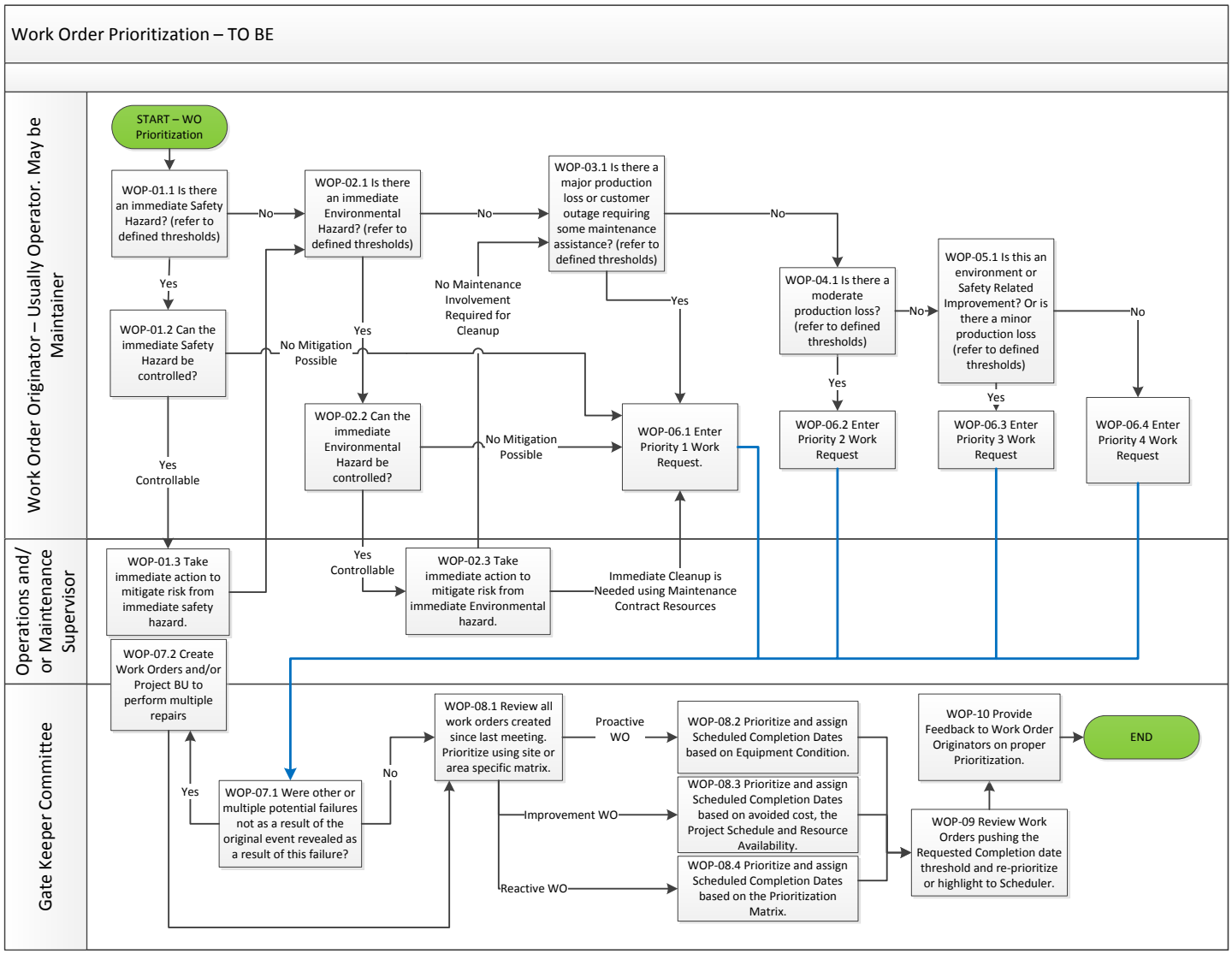
[8] Revision 2: Added this bullet.

Appendix I – Definitions and Business Rules

Business Process

Work Order Prioritization

The following sample business process provides only the first level of detail Information on the groups or individual positions, their associated *tasks (steps) in the process and high level descriptions for each step.*



Role	Step ID	Step Title	Step Description
ORIGINATOR	WOP-01	Safety Hazard Assessment	Safety Hazard Assessment: If a Safety Hazard exists, and the condition can be controlled, then do so. If the mitigation is beyond the control of the Originator or their supervisor, and Maintenance help is needed, then enter an Emergency Work Request.
	WOP-02	Environmental Hazard Assessment	Environmental Hazard Assessment: If an Environmental Hazard exists, and the condition can be controlled, then do so. If the mitigation is beyond the control of the Originator or their supervisor, and Maintenance help is needed, then enter an Emergency Work Request. If immediate cleanup is needed, then enter an Emergency Work Request. Follow rules of Environmental policy.
	WOP-03	Major Production Loss or Customer Outage Assessment	Major Production Loss or Customer Outage Assessment: If there is a Major Production Loss or a Customer Outage beyond the established thresholds, and Maintenance help is needed, then enter an Emergency Work Request.
	WOP-04	Moderate Production Loss Assessment	Moderate Production Loss: If there is a Moderate Production Loss beyond the established thresholds, and Maintenance help is needed, then enter a Priority 2 Work Request.
	WOP-05	Environmental or Safety related Improvement Assessment	Requests for Environmental or Safety related Improvement should be Priority 3.
	WOP-06	None of the above	If the work order is not related to safety, the environment, production loss or customer outage, then it is a Priority 4.
Gate Keeper	WOP-07.1 & 07.2	Are there other problems revealed?	WOP-07.1 Were other or multiple potential failures not as a result of the original event revealed as a result of this failure? If so, then create the Work Orders, and if necessary get a project approved and so code the Work Orders.
	WOP-08	Check All New Work Orders Prioritize AFTER Mitigation.	WOP-08.1 Review all work orders created since last meeting. Prioritize using site or area specific matrix. Make sure the type, priority, and coding is correct. Assign Requested Finish Dates.

Role	Step ID	Step Title	Step Description
			Assign Rough Cut Planned Start Date as an aid to the Planner in selecting which jobs to plan first. (The Planner may adjust the Planned Start Date after going through the Planning sub-process.)
	WOP-09	Make sure the Requested Finish Dates aren't in the past	If the Work is not being done as per the Requested Finish Date, then the work order must be reviewed and re-assessed for risk. It may be found that the equipment is in better or worse condition than expected, or that the mitigation chosen is more or less robust then anticipated.
	WOP-10	Feedback to Work Order Originators	Feedback to the Work Order Originators suggestions to improve their use of the Work Order Prioritization process.

Appendix 2 – Hydro Legacy Routine Work Prioritization Guide

Evaluation Factors:

1) **Importance = (a)*(b)*(c)*(d)*(e)*(f)**

(a) The work is: Reject if (a) = 0

Other	Corporate Mission Support	Justifiable	Necessary	Essential
0	1	2	3	5

(b) The loss type is:

None	Facilities / Equip.	Production	Delivery	Safety & Health or Environment
1	2	3	4	5

(c) Equipment Criticality:

Other	Standby Unit in Critical System	Critical to Plant or Station	Critical to Entire System	Critical Safety Protective Device
1	2	3	4	5

(d) Loss can be mitigated by:

Available Redundant Equipment	Available Backup Option	Nothing
1	3	5

(e) Loss probability is:

Low	Medium	High
1	3	5

(f) Loss Potential is:

Minimal	Moderate	Substantial
1	3	5

Total = (a)*(b)*(c)*(d)*(e)*(f)

Low	**Medium**	**High**
< = 72	**73 – 1619**	**> 1619**

2) Urgency:

How long can the work be delayed before the above loss is incurred?

Low		**Medium**	**High**
N/A	**> 1 month**	**<= 1 month and > 1 week**	**<= 1 week**

3) Priority Matrix:

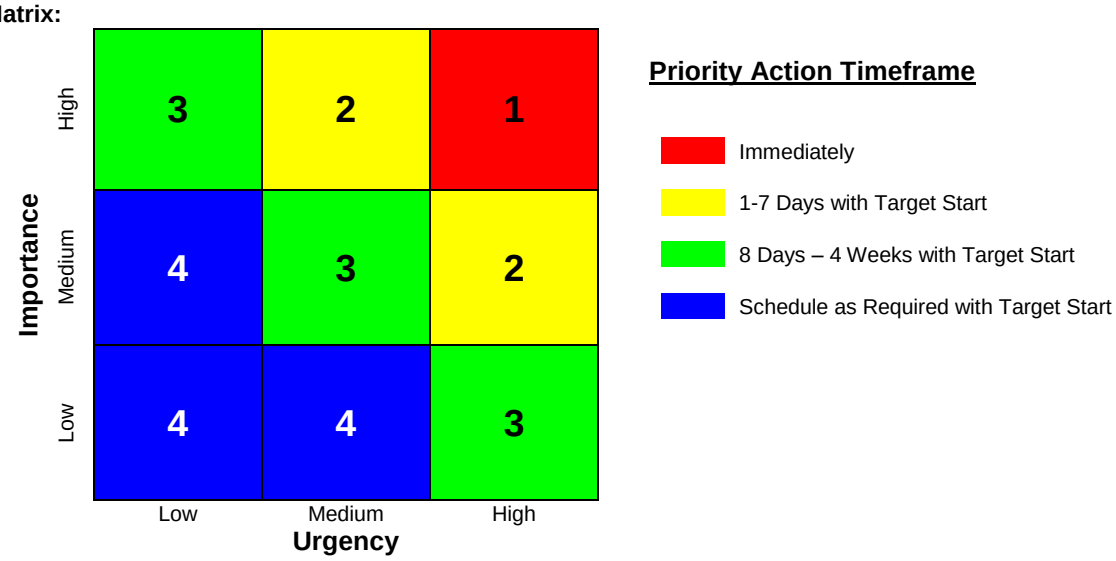


Figure 2 - Reference Hydro "Routine Work Prioritization, Rev. 5, 2004-11-10

Evaluation Factors:

The following provides some guidelines when assessing the range of each evaluation factor. Both importance and urgency can evolve due to changes in circumstances and these can ultimately impact the priority.

1. ***Importance***
    a. "The work is?" This factor covers the work category.
        i. Other: The work is not required and should be rejected if it doesn't fit into the following work categories.
        ii. Corporate Mission Support: At a bare minimum, our work should support our corporate mission by aligning to our goals and objectives. For example, enhancing our public image through provisions of materials and labour for municipal celebrations.
        iii. Justifiable: This refers to work that will provide a benefit to the company that outweighs its cost. These benefits may be financial or non-financial (E.g. Improved customer service index)
        iv. Necessary: This refers to work required to maintain facilities and operations in adequate condition to meet anticipated activity levels. For example, a derated unit at Holyrood may be required at full load within a week because of system load projections. More examples of necessary work would be JD Edwards is down (during normal service hours), the AS400 production machine is down, or the Corporate LAN is down.
        v. Essential: Work that is required to meet government regulations, legal requirements, or minimum environmental/safety standards. For example, work to address a class "A" safety hazard or work covered under the wood pole agreement with Aliant would be considered essential.
    b. "The loss types" are as follows:
        i. None if there is no loss associated with not performing the work.
        ii. Facilities/Equip. if there is a potential or existing loss of support facilities or equipment not directly related to the production or delivery of electrical energy. For example, line depots, regional offices, Hydro Place, servers, office equipment could be covered under this loss type.
        iii. Production if there is a potential or existing loss to equipment or systems related to the production of electrical energy such as hydraulic or thermal generating equipment, dams, control structures, etc. This type focuses on unit unavailability without having major customer delivery implications.
        iv. Delivery if there are potential or existing customer outages resulting from equipment or systems involved in the production, transmission or distribution of electrical energy. The focus here is on external customer outages due to generation unavailability, transmission line or distribution feeder outages.
        v. Safety & Health or Environment if the loss has or will have an impact on employee or public safety and health such as rotten wood poles, defective distribution disconnects, line road crossings, etc. or on the environment such as a potential contaminant release.
    c. "Equipment Criticality" asks for an indication of how critical the equipment is to the company's operations.
        i. Other is used to capture all equipment/systems that are less critical than those in the following groups.

ii. Standby Unit in Critical System would cover equipment like backup chargers in terminal stations, ring bus breakers in terminal stations, backup 230 kV line protection, parallel lines, etc.
iii. Critical to Plant or Station covers equipment/systems that are critical to a plant's or station's function such as line breakers, power transformers, RTUs, radial lines, etc.
iv. Critical to Entire System covers equipment/systems that are critical to the an entire system's function, whereby system is defined as the main power grid (interconnected island or Labrador) or any isolated diesel system,
v. Critical Safety Protective Device covers equipment/systems that are in place to provide safety protection in the event of equipment failure such as pressure relief valves, surge tanks, fire alarm/protection systems, etc.

d. "Loss can be mitigated by" covers the kind of mitigation that could offset the impact of the loss.
   i. Available Redundant Equipment covers equipment/system that is a direct replacement for the equipment experiencing the loss. For example, this would include a parallel battery bank charger, a parallel line or transformer, a spare diesel unit, backup line protection, etc.
   ii. Available Backup Option covers options that are not direct replacements but provide the same function. These options would usually come at some extra cost. For example, mobile substations/diesel units/ transformers, temporary bypasses, alternate feeds, etc.
   iii. Nothing covers the case where there are no options for mitigating the loss.
e. "Loss Probability" provides an indication of how probable the loss event may occur. This will require judgment based on equipment history and present condition and may also be influenced by external factors such as weather forecasts, load projections, system conditions, season, etc.
f. "Loss Potential": An assessment of the loss extent that could be suffered to people (loss of life, injury, etc.), environment (spills, exposures, hazards, etc.) and/or plant/asset/equipment/systems if the job is not completed soon. This is not a probability assessment but an indication of how much damage could occur. This again will require judgment based on system knowledge and external factors. For example, if delaying a job could result in no injury, low plant/asset/equipment loss and significant environmental loss, then the loss potential would be substantial due to the environmental factor. Another example could be a computer virus, which affects a few people but has the potential to affect every user. This case would have a substantial loss potential. The loss potential extent should also be evaluated in terms of its cost. For example, minimal loss potential could be a cost of less than $1,000. Moderate loss potential could be a cost of $1,000 to $10,000 and substantial could be greater than $10,000. These limits would have to be agreed upon before implementing this methodology. Another consideration is the loss's impact on the system. For example, if the loss is limited to local systems such as a local server, security system, air conditioning unit, vehicle, etc. or parts of systems such as a distribution feeder, a terminal station, a generating unit in a multi-generator plant, etc., then it may be considered a moderate loss. However, if the loss affects or will affect an entire system such as the Island grid, an isolated diesel system, an interconnected distribution system, the ECC control system, all PC users on the corporate network (E.g. Software virus), etc., then that should be considered a substantial loss. Staff productivity needs to be considered here in the case of losses associated with facilities or equipment like servers, buildings, printers, etc. The loss potential could range from one person (i.e. minimal) to all users (i.e. substantial).

2. Urgency

a. This factor takes into account the timing requirements of the work. This is again a judgment call that takes into account risks. One needs to consider the above loss potential(s), along with its probability, to

determine how long the work can be delayed before incurring the loss(es). Influencing factors could be weather or season, unit outage coordination, load projections, coordination with other higher priority work, or work type (E.g. Preventive maintenance, Corrective Maintenance, etc.). For example, an impending lightning or sleet storm may necessitate that work be carried out within the next 2 days or a planned unit outage may be coordinated with previously unidentified work to take advantage of the outage. In any case, the urgency chosen needs to be justified based on some risk assessment. The user will indicate N/A (i.e. not applicable) for work that doesn't have any losses associated with it.

3. Priority Action Time Frames

a. The following timeframes are merely guidelines for planners when scheduling work. They may be impacted by resource (human and goods & services) availability. The main emphasis is that higher priority work should get completed before lower priority work.

   i. **Priority 1** = Immediately (An injury has occurred or may occur; customer outage is ongoing or pending; necessary production is stopped or about to be stopped; or significant damage to plant/asset/equipment or environment has occurred or may occur. This is urgent reactive work of high importance, with no planning or scheduling within JDE).

   ii. **Priority 2** = 1 Day - 7 Days with target start date (Work must be started as promptly as possible with some planning done prior to it's commencement, as time permits. This is reactive work with some planning and scheduling within JDE.) This work is of an either high urgency and medium importance nature; or medium urgency and high importance nature.

   iii. **Priority 3** = 8 Days - 4 Weeks with target start date (This is important proactive work that is not urgent and must be fully planned and scheduled within JDE.) This work is of an either high urgency and low importance nature; medium urgency and medium importance nature; or low urgency and high importance nature.

   iv. **Priority 4** = Schedule as required with target start date (Any work that is required to be done but is not, at this time, affecting safety, health, environment, production or cost. It may be upgraded to another priority should the work become more urgent due to deteriorating or changing conditions. This is required proactive work of low to medium importance and low urgency or low to medium urgency and low importance that must be fully planned and scheduled within JDE).

Appendix 3 – Alternative WO Prioritization Matrix

Reactive Maintenance Prioritization Matrix

RISK = CONSEQUENCE x PROBABILITY

Consequence: Assess the work at hand against each consequence. Select the most severe.							
Classification							
SafetyImpact	No Safety Concern	Minor Safety Concern	First Aid	Recordable Injury	Recordable Injury and Lost Time	Fatality or multiple recordable injuries
Environmental Impact	No Environmental Concern	Any or low impact spill of non-hydrocarbon liquid	Hydrocarbon (HC) spill to land or containment < *x* liters. Chemical spill < *x* kg. Recordable spill.	Hydrocarbon (HC) spill to water < *x* liters. HC spill to land or containment between *x* & *y* liters. Reportable spill.	Hydrocarbon (HC) spill to water > *x* liters. HC spill to land of containment between *y* & *z* liters. Government Agency mobilizes.	Major fire . Severe environmental damage.
Equipment Failure Consequences	No equipment or Production concern.	Loss of production efficiency < *x* *Production Loss* < *x* MW. *Transmission* impact < *x* *Distribution* impact < *x*	Production efficiency loss > *x* . Production Loss between *x* & *y* MW. Transmission impact between *x* & *y* . Distribution	Fire < $ *x* damage. Production Loss > *x* MW. Transmission impact > *y* . Distribution impact > *y* .	Fire between $ *x* & $ *y* damage. Unit Shutdown. Transmission impact ?? Distribution Impact ??	Fire > $ *y* damage. Plant Shutdown. Transmission impact ?? Distribution Impact ??
Operational Flexibility	No Operational concern	Alternate operational modes possible. Installed Spare equipment installed.	Alternate operational modes. Spare equipment installed.	Marginal alternate modes for operation. Spare installed equipment.	Limited or restricted operation possible. Spare installed equipment.	Limited or restricted operation possible. No spare installed equipment.
Production or Asset Loss on Non-Routine /Projects	No Damage or Asset Loss	Minimal Damage or Asset Loss < $ *x*	Minimal Damage or Asset Loss between $ *x* & $ *y* .	Some damage, asset loss, or efficiency reduction. Cost between $ *y* & $ *z* .	Some asset loss, damage, or downtime. Cost between $ *z* & $ *z1*.	Significant asset loss, damage, and/or downtime. Cost > $ *z1* .
	Annualized Cost	< $ *x*	< $ *x*	< $ *x*	< $ *x*	Matrix

Probability: The consequence can reasonably be expected to occur		Reactive Maintenance Scale	Severity --> 0	1	2	3	4	5
	A	Occurring NOW or likely to occur in 1 - 2 days	Review Requirements to Decide how or whether to progress this work	3-1	2	1	1	1
	B	2 days to 2 weeks. Unlikely within 2 days.		3-2	3-1	2	1	1
	C	2 weeks to 3 months. Unlikely within 2 weeks.		4-1	3-2	3-1	2	1
	D	3 months to 6 months. Unlikely within 3 months.		4-2	4-1	3-2	3-1	2
	E	Likely to occur > 6 months. Unlikely within 6 months.		4-2	4-2	4-1	3-2	3-1

Figure 3 - Sample Prioritization Matrix. Refer to attached file for complete document.

Priority & Codes			
Priority	Definition	Target Date	Schedule Breaker?
1	Emergency	Begin Immediately	Yes
2	Urgent (High Priority)	Complete in 1 -7 days	Possibly
3-1	Routine	Complete in 14 Days	No
3-2	Routine	Complete in 30 Days	No
4-1	Routine	Complete in 90 Days	No
4-2	Routine	Complete in 365 Days	No

Generic AM Reactive WO Prioritization Mat

Figure 4 - The matrix result shall result in a Requested Finish Date[9]

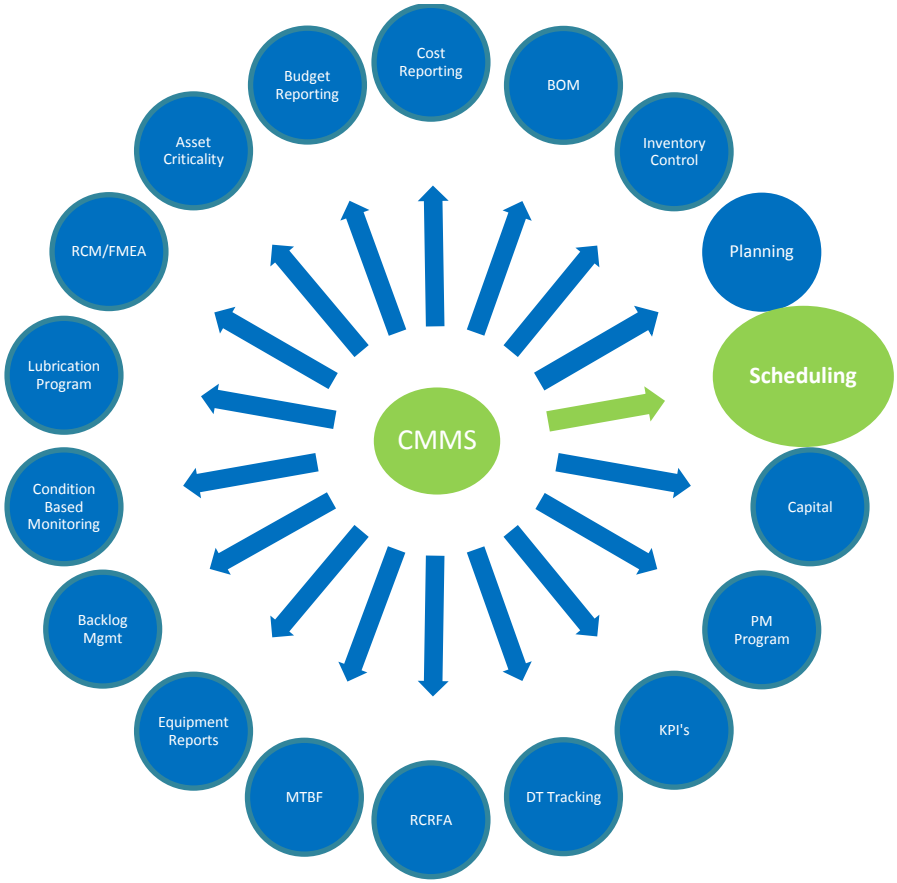
[9] Revision 2: Generic Matrix revised to use "Target Date, and to specify that while an Emergency should be started immediately, it will not necessarily be completed in one day.

Corporate Business System - ERP Assessment

Business Process Document

Scheduling - Asset Management

August 14th/2018



Version	Date	Description of Revision	Author
R1	Aug 20, 2015	Added Metrics section	S. McCarthy
R2	2016-12-20	Updated after process review	S. McCarthy
R3	2018-08-14	Updated after AM Champions Review	S. McCarthy

Contents

Purpose

The "scheduling function" is the hub from which all planned maintenance activity is coordinated. The Maintenance Scheduler is responsible for scheduling preventive and regular maintenance with minimal interruption to production operations. In this capacity, the Maintenance Scheduler is the principal contact and liaison person between Maintenance and Operations and other supporting departments in relation to determining the timing for execution of planned maintenance work. The Maintenance Scheduler works in coordination with the Maintenance Planner to ensure that Operations balance their need for daily output with their need of equipment reliability through proactive maintenance. The Maintenance Scheduler ensures that all internal customers of Maintenance receive timely, efficient and quality services. The Maintenance Scheduler will adhere to all Safety and Maintenance guidelines, to ensure a safe working environment and increase equipment longevity and improve labor productivity and equipment availability.

- Facilitation of weekly work scheduling meetings with Maintenance, Operations and other supporting departments.
- Attendance at, and if not facilitated by Maintenance first or second line supervision, facilitation of Daily Schedule Update and Coordination meetings with Maintenance, Operations and other supporting departments.
- Schedule and assign the work, integrating both customer (internal and external) and maintenance's needs.
- Develop maintenance shutdown schedules integrating all activities into one comprehensive plan.
- Coordinating maintenance work and projects.
- Creates and manage Maintenance schedules.
    - 5+ Year Long Term Schedule
    - 1 Year Integrated Schedule
    - 90 day rolling Schedule
    - 4 week Rolling Schedule (30 days)
    - Weekly Schedule
    - Shut down Schedule
- Generate metrics to demonstrate performance and guide process[1] improvements.

Scheduling – determining when an activity can be accomplished based on available resources.

Scheduling Includes:

[1] Replaced the word "drive" with "guide process".

- Assigning jobs to appropriate blocks of time based on external & internal resource availability, priority, material availability, and equipment availability.
- Confirming materials availability for scheduled work.
- Scheduling jobs in areas that require travel or that need the same equipment shut down in the same blocks of time.
- Preparing Gantt Charts for small Maintenance Outages based on Planned Work Order Steps and available resources.
- Approving Break-In Work
- Daily Coordination among Front Line Supervisors, to include the following:
    - Review jobs or work order operations that have hand offs to other Supervisors or groups.
        - Confirm the expected completion of predecessor activities
    - Higher priority jobs (break-ins) being worked
        - Impact on the weekly schedule.
        - Potential impacts on resource requirements from other groups
    - Reschedule jobs on the weekly schedule as needed.
    - During overhauls or other periods of intense activity, the Daily Coordination meeting requirements may become more formal.
- Weekly Schedule Preparation, to include the following:
    - Previous week's results.
        - Anticipated status at end of the current weekly scheduling period
    - Confirmation of available maintenance resources for the upcoming scheduling period.
    - Discuss additional work found.
        - Higher priority jobs (break-ins) being worked.
    - Discuss production work priorities.
    - Publishing a Resource Loaded Schedule for the next weekly scheduling period.
    - Agree on major backlog jobs to be scheduled.
- Weekly Schedule Compliance Review, to include the following:
    - Previous week's results.
        - Review Schedule Compliance statistics.
        - Identify off-schedule situations and reasons.
            - Identify sources of problems and delays.
        - Review corrective action taken.
        - Review Break-In Work.
    - Issues/lessons learned and feedback from actuals.
- Periodically purging the backlog.

Business Process - Scheduling Work Orders

The purpose of Scheduling is to sequence the work tasks in a manner that allows the safest and most efficient execution of tasks, and needs to include considerations for simultaneous operations, minimizing production outages, coordination between work disciplines, etc.

Schedules are developed in conjunction with the appropriate Operations, Engineering and Maintenance personnel.

- Work on assets by all groups must be integrated
- Examples of work that must be integrated into a single Maintenance Planning & Scheduling system:
    - Asset Integrity or Condition Assessment inspections by external consultants.
    - TRO working in a Plant's Terminal Station where a plant or unit outage is required.
    - Network Services working in a Terminal Station.

Type of Schedules where Schedulers are involved, in order of increasing levels of detail:

- 5+ Year Long Term Maintenance Schedule
    - The 5 + Year Schedule, whether by itself or as part of the schedule created and managed by the Long Term Planning group, identifies major projects such as new generation and transmission facilities, minor projects, and events such as outages and major PMs. The 5+ year Maintenance Schedule provides input to the 1 Year Integrated Schedule.
    - Larger or more important repetitive events should be included, such as Unit Overhauls, but the individual PMs that make up the Overhaul tasks do not need to be listed in detail
- 1 Year Integrated Schedule
    - Consists of major events for Maintenance and Capital, Shutdowns, Regulator Inspections, Rebuilds and events that affect production. It is at this time that PM and work orders may be assigned or assessed through forecast. This schedule is fed from the 5 year plan, PM Projections and Work Order backlog.
    - Provides input to the budgeting efforts for the upcoming year.
    - Resources should be loaded in the annual schedule to the levels defined and documented in either corporate or local procedures, corporately defined levels taking precedence[2].
- 90 day rolling Schedule
    - The Rolling 90 Day schedule is an update of the Annual schedule for major non-routine work activities, with detailed focus on the next 90 days. This scheduled is usually tracked, managed and updated monthly.
- 4 week Rolling Schedule (30 days)

[2] Revision 3: Added resource loading target for annual work plan.

    - Includes the activities from the 90 day schedule, and also the PM, PdM, and other maintenance activities known from the CMMS. The data for the Rolling 4 Week schedule comes from the CMMS system.
    - Work Order Start Dates should be assigned within the 4 week window.
    - Activities can be exported to Project Management Software at a detail level of one activity per work order or at an Operation Step level if desired.
    - Schedule loading by craft for each week is calculated and reported. Materials, external services, & special tools for the work are actively confirmed for delivery by scheduled date.
- Weekly Schedule
    - The weekly schedule is for the next 7 day period (i.e. Monday through Sunday) and is locked down when approved (before the Schedule Period begins). Tasks assigned should usually be able to be accomplished within the week-long schedule period.
- Shut down or Overhaul Schedule – May or may not be managed by the same group
    - These are typically major events that affect Operations, and often requires the management of work order tasks at a higher level of detail (i.e. shift-by-shift) than is done for weekly schedules.
    - Activities can be exported to a project management software where needed.

Backlog Review

An accurate backlog is necessary to be able to continually evaluate maintenance resource requirements and to successfully perform planning and scheduling activities. Duplicate work orders and jobs that have become irrelevant or impractical must be purged from the backlog, since they over-state resource requirements and distract from real priorities.

The Gatekeeper(s) have a role to play in the identification and removal of duplicate work orders, and in ensuring that work is not approved for Planning unless it is likely to be executed. The Planner(s) have a role to play in that any duplicate work that comes to their attention should be noted as such and returned to the Gatekeeper(s). In addition, to maintain an accurate backlog of work, periodic work order backlog reviews and purges must be performed.

The purpose of conducting recurring backlog reviews is to ensure that:

- Invalid work orders are removed.
- Valid work orders have their information, equipment number, coding and status updated where appropriate.
- Duplicate work orders are eliminated.
- Incomplete work orders reflect the current status of completion.
- Common problems with work order management are identified, and actions assigned to eliminate or mitigate the basic causes.

Initially, a number of joint meetings will probably be needed to review all backlog work orders, one-by-one. While this is tedious, it should be a one-time event if appropriate work order management

processes are implemented to keep the backlog clean. After this first effort, the meeting frequency can be reduced and the scope of review changed to cover discrete sections of the backlog. All backlog should have been reviewed annually.

Scheduling Process Metrics

The following metrics refer to weekly regular maintenance scheduling, and except where specifically noted, not to Shutdown (Outage) planning. Reports should be submitted to the Work Execution Manager so that appropriate action can be taken to address any gaps.

- All Work Orders in the Weekly Schedule are fully planned in the CMMS.
- All Work Orders with Planned Start Dates less than 30 Days out are fully planned in the CMMS.
- Schedule Loading by trade
    - Next week – target 100% resource loading for Maintenance trades, not for equipment resources (i.e. special tools or resource-limited equipment).
        - Based on resource loaded schedule produced by Scheduler divided by adjusted resource availability for upcoming week.
    - Two weeks out – target? (< 100%)
        - Based on planned work orders involving Maintenance trades where the WO planned start date is in the two week out period.
    - Three weeks out – target? (< 2 weeks out target)
    - Four weeks out – target? (< 3 weeks out target)
    - Five weeks out – target? (< 4 weeks out target)
- Overdue Work Orders
    - Number of Work Orders at status < In Progress with Planned Start Date in the past.
    - Overdue backlog by trade for Work Orders at status < In Progress with Planned Start Date in the past.
- Maintenance Planned Backlog by trade
- Unplanned Maintenance backlog
- Schedule Compliance
- Percent PM Compliance
- Percent Reactive Work
- Percent Proactive Work
- Repair Work Generated from PM's as a Percentage of all Proactive Work.
- Creation of weekly schedule compliance reports, and quarterly schedule compliance summary reports.
- Confirm that Work Order Backlog review meetings:
    - Are attended by at least a Maintenance and Operations representative;
    - Are held at least quarterly and minutes are kept identifying the participants, the work order groups reviewed and the results.
    - Review all of the work order backlog groups at least once in an annual period.

Scheduling Process Audit Requirements – Level 1

Scheduling determines when work should be performed based on priorities, the availability of the equipment for work, and the availability of personnel, materials and parts, outside services, and transportation.

- Work Orders are scheduled to be performed before the Requested Finish Date as assigned by the gate keepers.
- A Weekly Schedule procedure exists that includes:
    - A swim lane flow diagram detailing for the plant or area the responsibilities by position.
    - A requirement for a Weekly Scheduling Meeting with Agenda defined and requirements for keeping minutes defined.
    - A requirement for one or a group of Daily Scheduling Coordination Meeting(s).
- Targets are set for work order backlog by trade, in weeks based on expected resource availability.
- Schedule Compliance is measured, issues documented, and recurring issues followed up and action documented.
- Work Orders are scheduled in the Weekly Schedule at least at a Work Order Level.
- Existence of Break-In approval procedure
    - Confirmation of the knowledge and use of the Break-In approval procedure by Operations and Maintenance and Project and Administrative personnel.
- Creation of quarterly Schedule Compliance review reports
    - Confirmation of evidence of feedback through front line management of unforeseen events that resulted in delays in execution of the work.
    - Show evidence that such feedback was used in some concrete way to improve Scheduling effectiveness.
- Agenda for weekly scheduling meeting with appropriate participants and agenda items.
- Confirmed appropriate use of Work Order Planned Start Date
- Existence of Annual Schedule at appropriate level of detail.
- Show the results of weekly 30 Day Schedule material quantity reviews, and evidence of corrective action taken in the event of shortages.
- Show evidence that Capital Project Work is not creating demand in the MRO Warehouse, and thereby artificially inflating inventory value and invalidating MRO Purchasing history as an input to decisions on stocking level.
- Show that all Major Shutdown Work Orders for Maintenance are fully planned in the CMMS when the shutdown scope is locked down, or 2 months prior to the shutdown, whichever comes first.
- The Plant/Area has a documented Scheduling procedure aligned with the corporate standard procedure in sufficient detail to provide guidance in implementing the procedure, executing the procedure, and training appropriate personnel. The Procedure is approved by Plant/Area

Management,[3] published and available to view. Personnel involved are familiar with the procedure and its contents.
    - The Scheduling Procedure includes a procedure for Break-In approval and review.
- The Plant/Area has a documented Scheduling Training Plan covering process, standards, and use of the CMMS and associated tools. The Scheduling Training Plan is being followed.
- The CMMS Procedure is adhered to in Scheduling in the use of Work Orders, Work Order status codes, Work Order planned start and Requested Finish Date, etc.
- The Standard Work Order procedure is adhered to in the use of Model Work Orders to record learnings from Schedule Compliance reviews.
- Scheduled Preventive Maintenance jobs are performed when due, with exceptions explained.
- A guideline for documenting resources available for Maintenance work in the coming 5 week period, and especially for the coming weekly schedule period, shall be defined. The guideline will include in what cases and for what reasons any maintenance personnel who are available for work are excluded from the available maintenance resources used to calculate schedule loading.[4]

Scheduling Process Audit Requirements – Level 2

Level 2 is built on the requirements of Level 1.

The intent of this procedure is to ensure that the Scheduling Procedure fully utilizes the Scheduling Tools inherent in the CMMS in the development of the 7 Day and 30 Day Schedules, and to ensure that PM routines are scheduled and executed on time.

- Plan and Schedule all work 30 Days in the future, in the CMMS.
- Schedule Major Jobs at least 12 months in advance.
- Review the Annual Schedule monthly and update major outage windows and major project start dates
- Confirm the 90 Day Schedule monthly and reconfirm Maintenance trade resource loading and equipment availability for work.
- Provide familiarization training to selected [5]Operations and Maintenance and Project personnel in the Weekly, 30 Day, and Annual Scheduling procedures
- Confirm Materials for 30 Day Schedule are On Hand and if not, take corrective action.
- Maintenance trade resource levels and information on scheduled time off are available from the CMMS, and used for resource loading calculations.
- Work Orders are scheduled in the Weekly Schedule at an Operation (Routing) step level.

[3] Revision 3: Added approval for area procedure.

[4] Revision 3: Added documentation of reasons for excluding maintainers from resource availability.

[5] Revision 3: Specified that selected personnel to be familiarized with how work is scheduled, This is in order to promote early notification of the need for maintenance assistance.

Approvals

	(name)	(signature)	(yyyy/mm/dd)
	(name)	(signature)	(yyyy/mm/dd)

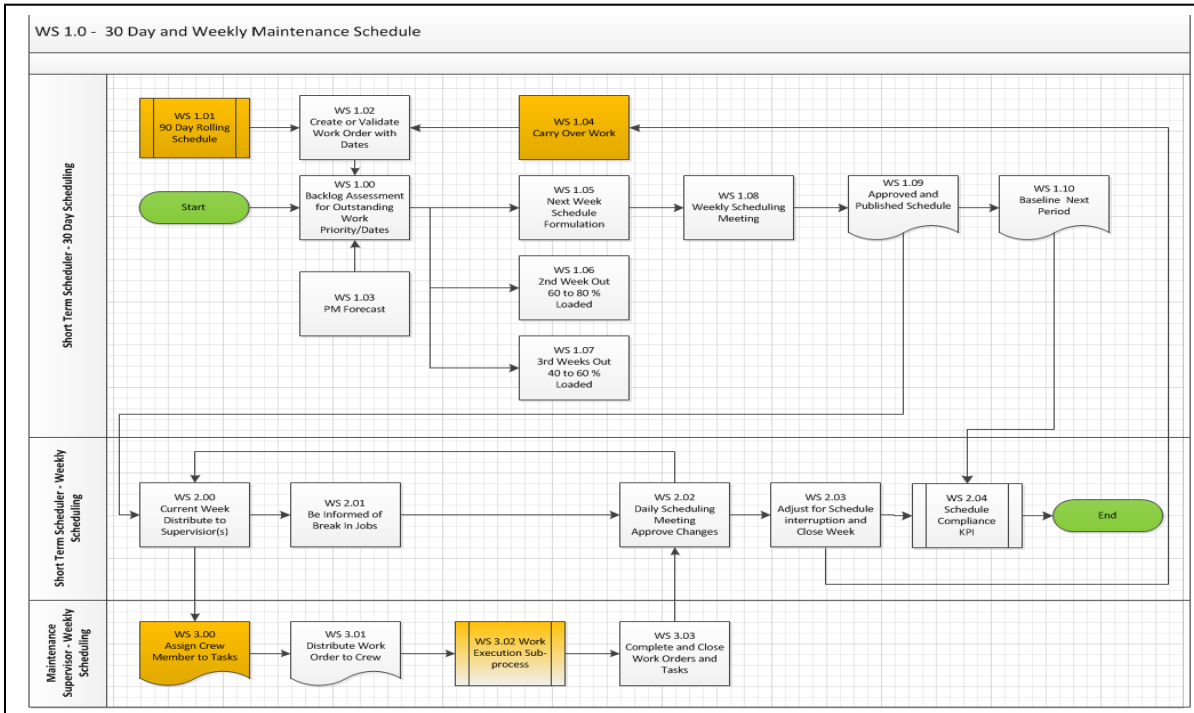
Appendix I – Definitions and Business Rules

<< Add any agree upon business rules or definition associated to the business processes.>>

Business Process

Work Order Scheduling

The following sample business process provides only the first level of detail Information on the groups or individual positions, their associated tasks (steps) in the process and high level descriptions for each step. This is an overview of the 30 day and 1 week schedule.



Role	Step ID	Step Title	Step Description
Short Term Scheduler - 30 Day Scheduling	WS 1.00	Backlog Assessment	The first step a Scheduler must do is to poll the Annual Work Plan and the Work Order backlog ready for scheduling. Though there are several other inputs that must be considered, should be the primary source for the formulation of the Next Period Scheduling requirements. A Scheduler main work effort is with the coordination with Maintenance and Operations, and agreement of the work to be accomplished in an upcoming or future period. The Scheduler is to validate and load the crew's capacity load, be it one or many trade disciplines. Normally the Schedulers will use Planned Start Date as to meet the Required Planned Complete dates, as well as critically to define which job should be selected to load. Schedulers should not be loading any trade group higher than the agreed upon capacity. If target dates cannot be met there may be an escalation to Supervisor, Superintendent, or Gate Keeper Committee to reevaluate the following • Requested Finish Date • Overtime Considerations • Contracting Out Schedulers should always be forward looking and normally will have Jobs or tasks spread over several periods. Including Current Week a minimum of a following three periods should be in some state of Scheduling and coordination with Operations and a full 30 days from current is good.
	WS 1.01	90 Day Rolling Schedule	The 90 Day Rolling Schedule is a portion of the agreed upon Yearly Plan. These requirements may or may not already be a Work Order. Schedulers may need to coordinate with the Planner or Long term Planner for the creation of these in a work order and task requirement
	WS 1.02	Create or Validate Work Order	Work Order Create and Date validation may require feedback to the Planner group where dates are aged out.

Role	Step ID	Step Title	Step Description
	WS 1.03	PM Forecast	Schedulers should be forward looking and should consider upcoming impact from the PM system and how and who this will affect. I may be a decision to manually create these PM early as to assign them to a Scheduling Period. (this assumes that PM's are fully Scoped jobs)
	WS 1.04	Carry Over Work	Carry Over Work is a term for job tasks that were not completed, that had been scheduled. Carry Over Work does not necessarily fit into the week following, and will have to consider the condition of the equipment, especially relevant when equipment shut required.
	WS 1.05	Next Week Schedule	Next Week Schedule – Should be the list of jobs or tasks that will be completed "Next Week". At this time it is only a bulk load of hours by trade disciplines. There may be hard dates due to equipment shut requirements and coordination with Operations is required. It is up to the Scheduler to coordinate these dates with Maintenance, Operations and possibly the Asset Specialist and Short Term Planning. Scheduler should be focused on bulk loading and not on Resource loading. It is also at this time that the Scheduler should be verifying with Warehouse the parts availabilities and adjust or expedited if required.
	WS 1.06	2 Weeks Out	Similar to any future period – is a labour load of planned work orders. These future periods should not be to the level loading of the Next or Current Week period. Targets for level loading should lose around 10 to 20% per period. (This does not apply for Shut Down Periods) or 80% loaded
	WS 1.07	3 Weeks Out	Similar to any future period – is a labour load of planned work orders. These future periods should not be to the level loading of the Next or Current Week period. Targets for level loading should lose around 10 to 20% per period. (This does not apply for Shut Down Periods) or 60% loaded
	WS 1.08	Weekly Scheduling Meeting	The weekly meeting should be a natural extension to the daily meeting. The main difference may be the complement of personnel; this may require coordination with all related Schedulers (e.g. Shut Down) and Operational personnel. It is from this meeting

Role	Step ID	Step Title	Step Description
			the Approved schedule should be finalized for the "Next Period". "Current Period" tasks should be assessed for completion, or forecast completion or rescheduled.
	WS 1.09	Approve and Publish Schedule	Once the changes have been made this should be posted and communicated as the approved Schedule.
	WS 1.10	Baseline the Schedule	This baseline or frozen Schedule should be "banked" and used for as one of the measurement or assessment KPI of both Planning and Scheduling. This will be used for a Key assessment once the "banked" scheduled period has been completed and then compared to the actual.
Short Term Scheduler - Weekly Scheduling	WS 2.00	Distribute to Supervisor(s)	Once the weekly scheduled is approved, the scheduler should create the job packages and ready for distribution. The scheduler will distribute the job packages to the Supervisors and forward the parts requirement to inventory for "Bag and Tag" and even for delivery. Different sites may have different requirements due to remoteness of site. *****It is also at this time that any requirement for interface or updates to feed into a Project tool for the Weekly Schedule may take place*****
	WS 2.01	Be Informed of Break in Jobs	Break in Jobs are task that have not been scheduled but due to Operations, Environment, or SWOP are required. True emergencies will always be an after the fact plan, some will be already actively being worked on while others may be brought to the Gate Keeper (Work Order Review) Meeting for approval. The Short Term Scheduler must be Informed of Break-In Jobs, but is responsible to adjust neither the daily schedules nor the in-execution weekly schedule as a result of the break-ins. *****There should be a defined Break in Approval process to follow*****
	WS 2.02	Daily Scheduling Meeting	Daily meeting should track the health of the current Schedule and could include the following: • Previous day's results. • Review jobs completed. • Identify off-schedule situations and reasons.

Role	Step ID	Step Title	Step Description
			• Review corrective action taken. • Discuss additional work found. • Current day's results. • Higher priority jobs (break-ins) being worked. • Problems and delays. • Anticipated status at end of shift. • Jobs that require unexpected overtime. • Future schedule. • Reschedule jobs as needed. • Discuss production work priorities. • Agree on major backlog jobs to be scheduled. • Issues/lessons learned and feedback from actuals.
	WS 2.03	Adjust Schedule and Close Week	Adjusting of the schedule can happen many times within the Scheduled Period, and coordination with Supervisors is critical as to adjust where required. The last daily scheduling meeting of the period also is the time to verify and validate the required closing of the open task, work orders, or identify which task will have to be Carried Over. It is also at this time the continuous improvement and feedback to the Planning group should take place. Identify where the plans worked well and where they were deficient. This communication or feedback can be instrumental in updating PM, Standard Jobs or even be the cause for reassessing the PM requirements for your assets.
	WS 2.04	Schedule Compliance KPI	Once the weekly Schedule has been closed, the closed actual can be measured against the Frozen or "Banked" Schedule for creating the Weekly Scheduling KPI.

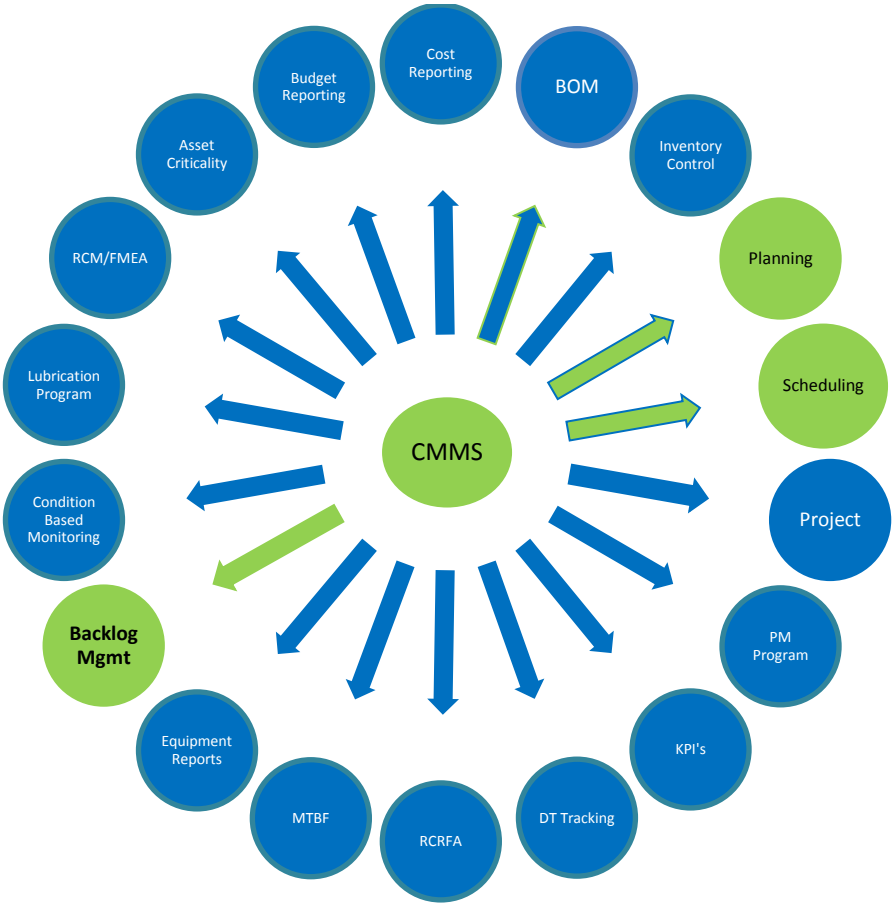
Maintenance Supervisor – Weekly Schedule	WS 3.00	Assign Crew Member to Tasks	Though it is critical that the scheduler control the bulk loading of Task to Crew Capacity, and to identify hard dates (where coordination with Operations is Required), it is just as critical that the Crew Supervisors manage who from their crew should be assigned the jobs or task. They also have an impact on the daily smoothing of work with the schedule period.
	WS 3.01	Distribute Work Orders to Crew	It is the Supervisors responsibility to go over the distributed work orders with the assigned trades' personnel. Morning Meetings, Tailgate Meetings should be one of the main ways to communicate as well as daily work order being posted.
	WS 3.02	Work Execution Sub-process	The work execution sub-process is covered elsewhere. For the purpose of the weekly scheduling process, it is important to note that the Maintenance Supervisor is responsible for managing break-ins to the current weekly scheduling period, and not the Scheduler or Planner.
	WS 3.03	Complete and Close Work Orders and Tasks	It is critical that the crew Supervisor make sure that the Tasks and/or work orders are being identified for Complete and closed. This is a primary measure on the current health of the Schedule period. Without these activities you will not have an accurate daily completion and percent complete of the Scheduled period.

Corporate Business System - ERP Assessment

Business Process Document

WO Management- Asset Management

August 8th/2018



Version	Date	Description of Revision	Author
R1	Nov. 25, 2015	The use of equipment numbers on non-maintenance work orders is discouraged.	S. McCarthy
R2	May 24, 2016	Added RACI Chart	S. McCarthy
R3	2016-12-20	Updated after process review	S. McCarthy
R4	2018-08-08	Updated based on AM Champions' Comments	S. McCarthy

SCOPE:

The scope of this document includes the general requirements for asset management work order management.

Contents

Purpose

Maintenance is defined as the combination of technical and administrative actions—including supervision actions—in order to preserve or maintain an equipment state to perform a required function. - maintaining means making sure that an asset continues to perform the functions it was designed for.

In a restricted sense, maintenance activities are limited to returning an asset to its original conditions. In a broader sense, maintenance activities involve changing its original conditions by introducing improvements to prevent failures from occurring or recurring; optimizing cost and increasing both maintenance and asset productivity; ensuring safety and reliability; and protecting the environment.

No maintenance activity can increase the asset's functional capability or its reliability without improvements. Therefore, improvement activities must be considered as part of maintenance, which is under responsibility of Maintenance Engineering. Under normal conditions this would require a Project for improvement to monitor changes to the original design and current rating or throughput of the system.

The work order Procedure is the backbone behind any effective maintenance system. Work orders are used to manage the work flow of maintenance tasks and projects. Work orders are created for preventive (PM), corrective/repair (CM) maintenance and Project Improvements. The progress of work orders is tracked by status. All maintenance work must be performed from a work order. First and foremost, each site must adopt the policy that all non-emergency maintenance work must be performed from an approved work order from the Gate Keepers. This ensures that all work is recorded and can be analyzed. If this rule is not followed, cost, various metrics, and history records will not be accurate or meaningful.

Business Process –Work Orders

An Asset Management Work Order is not merely a cost collection bucket, but rather separate work orders should be created for discrete, fixed scopes of work with a definable start and end point. If the work scope is not known, then the work order can neither be planned nor scheduled.

Work Order Types

- Corrective
    - Corrective Work Orders are to be created whenever an equipment failure is found to have happened or to be in progress.
    - A Work Order is not classified as a "Corrective" work order merely because the cost is being charged to Operating expenses.
    - A Corrective Work Order can be charged to an operating BU, to a Maintenance Project BU, or to a Capital (Job Cost) Project BU.
    - All Work Orders for repairs are "Corrective Work Orders". Corrective Work Orders are used only for repairs. Corrective Work Orders are not used for any requests for changes

to plant, equipment, or process; nor are they used for activities unrelated to repairing functional equipment.[1]

- Improvement
  - Improvement Work Orders are to be created for any change to plant, facilities, or process.
  - Improvement Work Orders include Maintenance and Capital projects, but also any requested changes to plant, equipment, or process.[2]
  - A Work Order is not classified as "Improvement" merely because it is to be capitalized.
  - An Improvement Work Order can be charged to an operating BU, to a Maintenance Project BU, or to a Capital (Job Cost) Project BU.
  - Equipment Numbers should not be used on all Improvement Work Orders. Refer to Appendix 1 for a decision diagram on the use of equipment numbers on work orders.
  - It is critical that changes to equipment and process be reviewed, approved, and managed correctly to avoid unforeseen consequences. Many catastrophic failures have resulted from a combination of several seemingly inconsequential changes.[3]
- Non-Maintenance
  - Non-Maintenance Work Orders are created for activities that are neither repairs nor are they Improvements or PM related.
  - Non-Maintenance Work Orders are not to be coded with an equipment number, since the use of virtual equipment in order to track program costs is discouraged.
- Preventive
  - Preventive Maintenance Work Orders are always system generated work orders.
  - PM Work Orders are always created against equipment records.
  - Preventive Maintenance Work Orders are generated based on some schedule of intervening days, hours or some other meter between occurrences, and can also be related to seasonal work.
  - Because a Work Order is generated from the PM Module in the CMMS, it is not necessarily a PM Work Order; any Work Order type can technically be created from the PM Module.

Maintenance types

- ***Unplanned Reactive Maintenance*** *– Performed after a previously unidentified failure occurs. Allowing equipment to run-to-failure may be less expensive in the short-term in terms of maintenance costs, but the failure may have higher consequences due to safety, environment, or production downtime effects. In order to minimize consequences when a failure happens, you must have the necessary resources (replacement parts, tools and labor) to act quickly. This is often a burden for maintenance.*
- ***Planned Reactive Maintenance*** *– Corrective Maintenance carried out after the identification of the functional failure, when this information is obtained after routine systematic technical*

[1] Revision 4: This clause moved to this section from Appendix 1
[2] Revision 4: This clause moved to this section from Appendix 1
[3] Revision 4: This clause moved to this section from Appendix 1

inspections or by identification from those personnel or customers next to the assets. Planned Reactive strategies may come from Condition Based Monitoring programs, or from the failures of non-critical equipment.

- ***Planned Proactive Corrective Maintenance*** [4]***-*** *Performed after the failure is identified, but the equipment itself is not yet in a failed condition. Planned Proactive strategies may come from Condition Based Monitoring programs, Operator Routine Duties, or PM Inspections.*
- ***Time-Based Systematic Preventive Maintenance*** *– Involves some systematic tasks, such as inspections, refurbishments and part replacements. From the maintenance cost standpoint, it is not the most cost-effective type, because the parts are replaced and the components are refurbished before their end of life. From the production standpoint, it is very appropriate, because it ensures a more reliable working period for the asset.*** Go to PM Sub Process*
- ***Condition-Based Systematic Preventive Maintenance (Predictive)*** *– The conditions of a part or assembly are monitored throughout its life cycle, using special analysis techniques (vibration, oil analysis, thermography, etc.). These activities allow us to diagnose when a part or component is approaching its end of life, so that we can optimize maintenance planning (replacement or refurbishment) and even extend the maintenance interval. These activities are carried out while the asset is in operation. The techniques provide optimal results and optimize the cost in the long run.*
- ***Asset Improvement or Project Improvement*** *– Making gradual and continuous improvements in the assets beyond their original specifications. You can make these improvements using the Kaizen concept, which can be understood as ongoing asset/process improvements. This may result in changes in the project and in operation/maintenance standards as needed.*

Gate Keepers

There are many steps to be performed by the Gate Keepers to screen and validate Work Requests. To effectively screen work requests, there should be a single point of contact between operations and maintenance. In this process, this is called the "Gatekeeper". The personnel on the Gatekeeper committee should validate several things within the request by asking the following questions.

1. ***Is this a duplicate request?*** *- Has someone already written a request for the same work? Duplicate requests cause confusion within the maintenance department. An approved duplicate request also creates a second record in the history file that can be viewed as two separate occurrences. Duplicate records should always be moved to status (rejected) no matter who finds the duplicate record. Only one work order per event or problem for the same equipment tag should be allowed. The maintenance person who is assigned the work order is responsible to coordinate with any sub groups that he needs to complete the job. Example: If there is an instrument that needs calibration and it requires scaffolding, the supervisor assigned the work order will need to communicate with scaffolding supervisor. He will also be responsible to get scaffolding removed before he can complete the work order.*
2. ***Is there enough information on the request for maintenance to understand the problem?*** *– If the problem is not described or if the work order does not have the appropriate information to act on, the Gate Keeper(s) can send this back for more information or reject.*

[4] Revision 4: Added descriptions of Planned Reactive versus Planned Proactive Maintenance

3. ***Has the correct equipment number been listed?*** *- This is important for at least two reasons. First it is important to know the cost of each repair. Costs can be attached to the equipment only when the proper tag number is assigned. Second, and perhaps more important, is that the tag number is used to attach history information that can be later used to prevent repeat failures, etc.*
4. ***Is the Work Order Type Correct?*** *– Corrective Work Orders should not be used for Improvements. A repair or a PM charged to a Capital Project does not become an Improvement Work Order.*
5. ***Is the Corrective Work Order categorized correctly to allow assessment of proactive and reactive work percentages?*** *– Corrective work orders can be proactive or reactive, mainly depending on the point on the P-F curve at which the failure is discovered.*
6. ***Does the work request include the correct priority?*** *– follow Priority sub process*
7. ***Who should be assigned the request?*** *- One maintenance supervisor should be responsible to complete the work order. The use of routing instructions should be used by the planner to determine trades involved.*
8. ***Can this work be completed without a facility shutdown?*** *– Code Work Request for the equipment condition required to do the work.*
9. ***Does this relate to a current Project or Require an Improvement Project, or does this bundle in with other Operational Project jobs?*** *– Where required request the creation of a new project, and reassign to the cost center for that Project and also code the Subsidiary (Cost Code or "Work Breakdown Structure" (WBS)).*

Standard Repair Procedures (AKA Unscheduled PM's[5])*Standard Repair procedures are built and added to the CMMS as Model Work Orders with PM Maintenance Services that are configured to create Corrective Work Orders instead of PM Work Orders. The function is referred to as "Unscheduled Maintenance". These services can be created directly from the WO Backlog application when and as needed.*

In the Planning process, detailed procedures can be linked to work orders and routing steps (tasks), in their native format (i.e. Word or pdf), or as text. Understand what documents will print with work orders or be available to connected or disconnected mobile applications when deciding the method of providing the documentation.

WO Management Process Assessment – General Requirements

1. The plant or area has a documented procedure in a standard format aligned with the Nalcor procedure in sufficient detail to provide guidance on deployment, execution, and training requirements, including roles and responsibilities. The procedure is rolled out and visible to the organization.
2. A training plan is in place and followed.
3. Nalcor standards are followed in Work Order creation and use of codes, where and how equipment numbers are assigned to work orders, and the use of the Nalcor CMMS system is rigorous.
4. The Work Order review and approval process is established and adhered to in the organization.

[5] Revision 4: Standard Repair Procedures are also known as "Unscheduled PMs" in JDE E1

5. All work related to production, generation, and transmission equipment is managed on work orders.
6. Rough Cut Planned Start Dates and Requested WO Finish Dates are entered and managed.
7. Multiple Work Orders for any one failure are not used.
8. Work Orders are coded to the appropriate BU and Project/Cost Code.
9. Action Metrics
    - Percent Work Order Utilization
        - Craft Hours / Available Craft Hours
        - Work Order Costs / Actual Costs
    - Number of open work orders by age.
    - Percent Reactive Work.
    - Percent Proactive Work.
        - Percent Proactive Corrective Work.
        - Percent of Preventive and Predictive Maintenance tasks that result in a Corrective Work Order.
    - Percent Emergency Work.
    - Schedule Compliance
    - Maintenance Overtime.
    - Inventory Fill Rate
    - Percent Planned Work.
    - PM Compliance
    - Craft backlog & trend in weeks.
    - Planning efficiency.
10. Result Metrics
    - Availability or SAIDI
    - Lost Production (MW-Hrs or Customer Hours)
    - Major Rotating Equipment Availability
    - Maintenance Cost as a percentage of plant/Area controllable costs
    - Critical Equipment MTBF
    - Increase in quality and quantity or equipment data records linked to CMMS.
11. Improvement Work Order Metrics
    - Review Improvement Work Orders to determine whether work orders are created several weeks in advance of the need for Maintenance support.
    - Review Improvement Work Orders against Projects to determine to what extent the budgeted Maintainer requirements match the actual requirements.
    - Review the priorities assigned to Improvement Work Orders to determine whether the Prioritization Matrix is being followed.
    - Review Corrective Work Orders executed in the assessment period to identify inappropriate usage of Corrective Work Orders for Improvements.

- Review Maintenance labour costs charged to other than Corrective, Improvement, and PM Work Orders against project or capital accounts to identify improper work order usage.
- Review Improvement Work Orders to determine whether the scope of work is defined in enough detail for planning and scheduling.
- Review Improvement Work Order labour estimates to check whether duration estimates are exceeding stated maximums.
- Compare actual-to-estimated values for Improvement Work Orders to determine whether there exists any problem with estimating work scopes.
- Check the subsidiary codes assigned to Improvement Work Orders to ensure that the work package matches the work scope defined on the work orders' description.
- Review Improvement Work Orders to confirm that the scope of work for "Shutdown", and "On-Line" work are defined on separate work orders.

Approvals

	(name)	(signature)	(yyyy/mm/dd)
	(name)	(signature)	(yyyy/mm/dd)

Appendix I – Definitions and Business Rules[6]

1.

[6] Revision 4: Business Rules were removed from this section and included in the work order type definitions.

Decision Diagram for WO Business Unit and Equipment

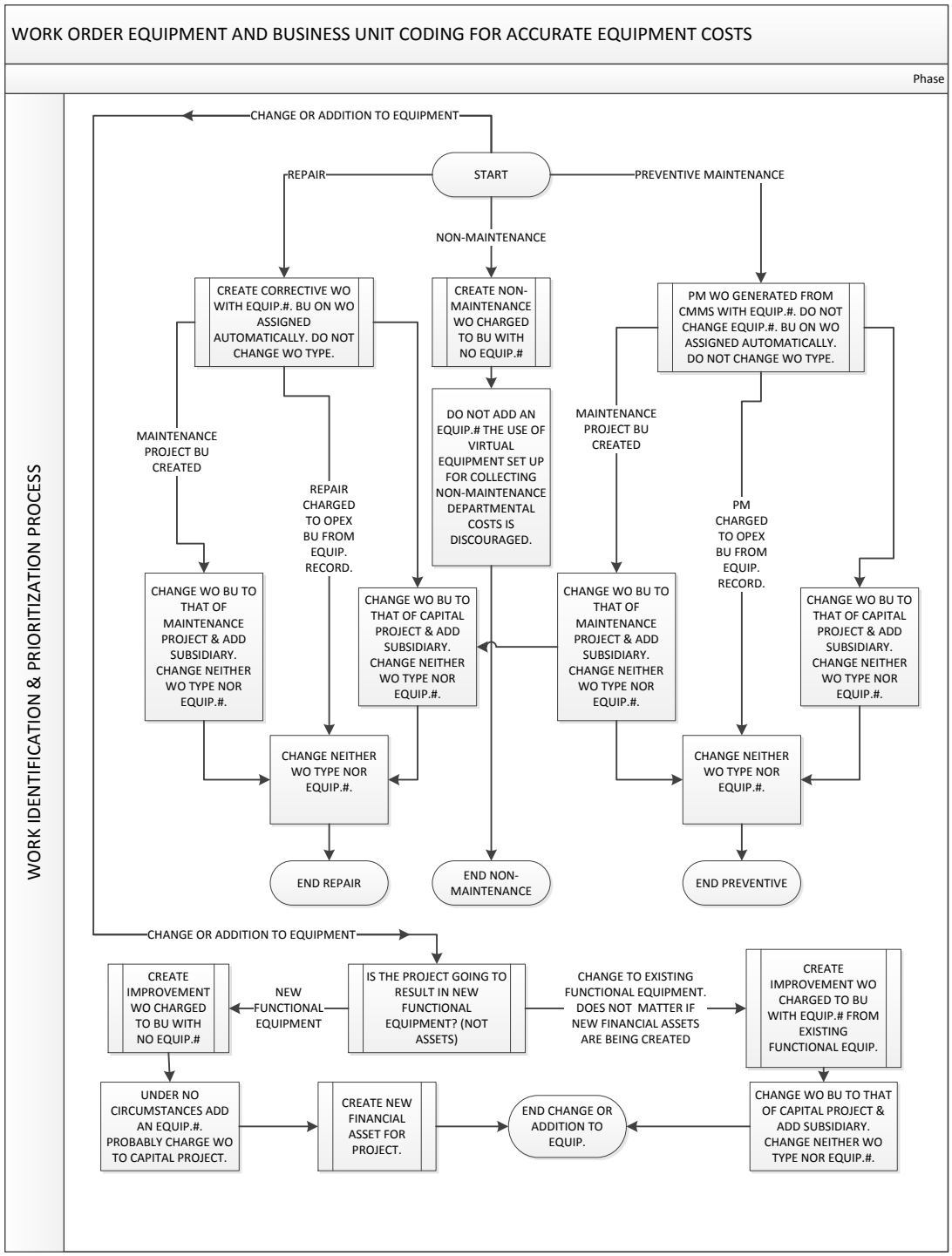
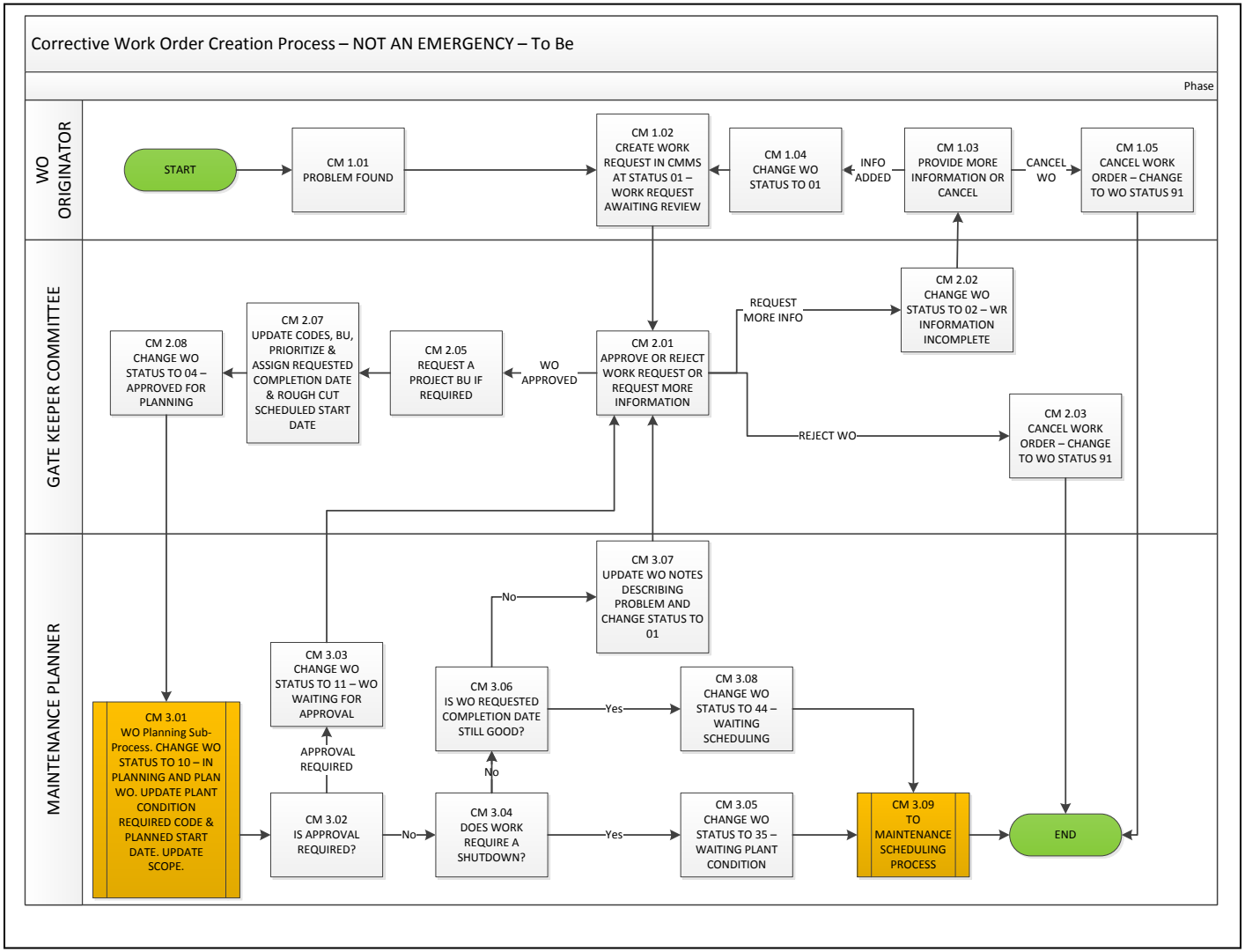


Figure 1 - The Use of Equipment Number and BU by Work Order Type

Work Order Business Processes

Business Process – Corrective Work Order

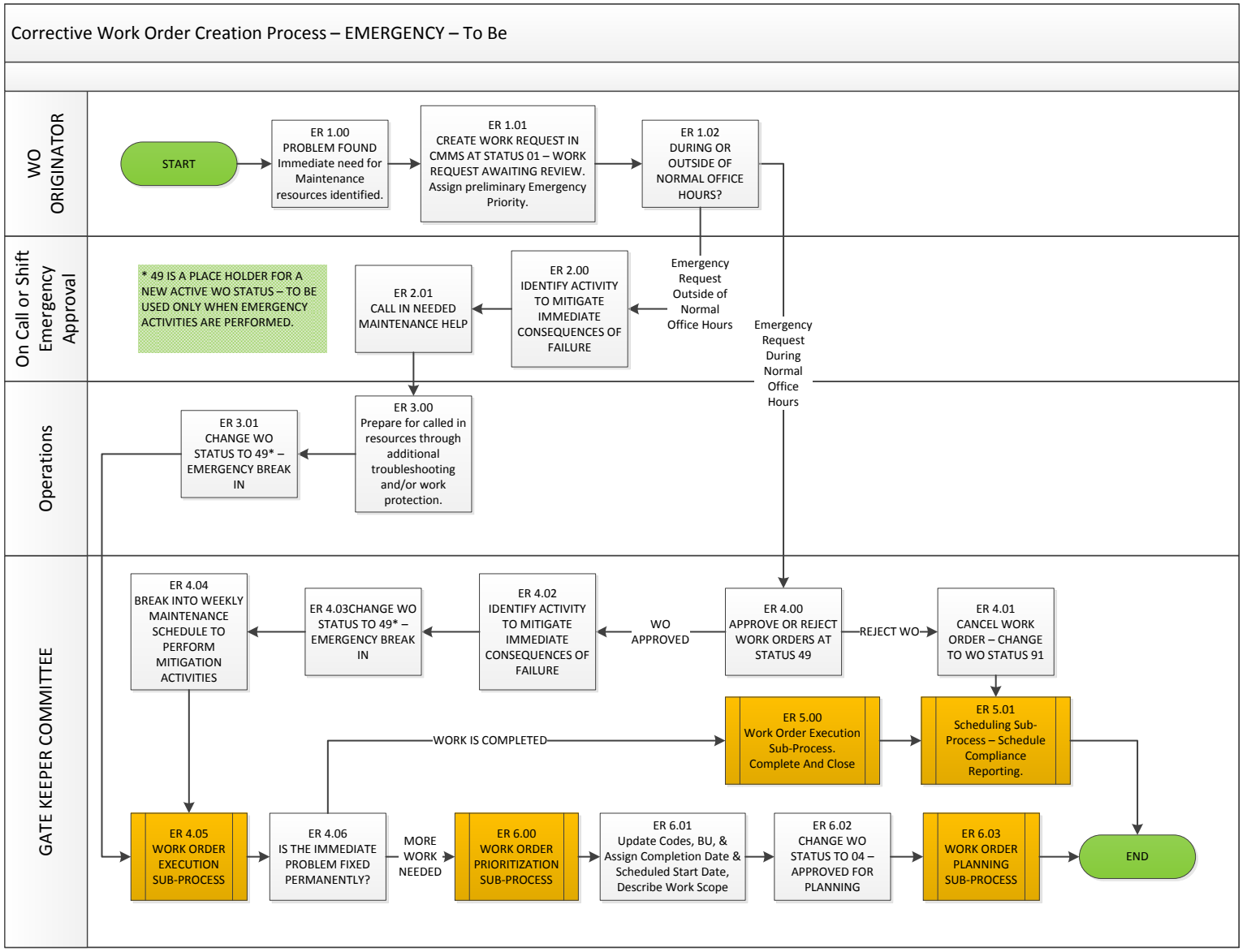


Role	Step ID	Step Title	Step Description
WO Originator	CM1.01	Problem Found	
	CM 1.02	Create Work Request in CMMS	It is important all critical information is given as to allow the Gate Keeper(s) to assess the importance or validity of these Work Requests – Proceed to CM 2.01
	CM 1.03	Provide More Information	If additional information is required the Gate Keeper(s) will return these work requests back to the originator for completeness of the request.
	CM 1.04	Change WO Status to 01	Once corrected change order back to status 01
	CM 1.05	Cancel Work Order	If between the time the order is written and the return back to the Originator the request has been corrected or is no longer required. Add the information to the Request and change the status to Rejected
Gate Keeper(s)	CM 2.01	Approve or Reject Work Request or Request more Information	The Gate Keeper(s) is the approval board for new Work Requests. Main duties consist of • Checking for the completeness of Request – or send back for additional information • Look for duplications or other work that would incorporate the identified correction – where duplications exist normal set would be to reject with reason
	CM 2.02	Change WO Status to 02 – Information Incomplete	If more information is required will send back to originator
	CM 2.03	Cancel Work Order	It is important that work requests are rejected with a reason for originator feedback
	CM 2.05	Request a Project BU if Required	If requests requires modification to the original design, or if major repairs, or like repairs may require that these be added to a Project. If Project does exist – attach proper Project number; if not these jobs may be held till the new Project request is completed or progressed and the transactions' costs backed out when the Project Number has been created. Once the Project is set up – update work order to the correct Project cost center.

Role	Step ID	Step Title	Step Description
	CM 2.07	Update Codes, BU, Priority, Date	The Gate Keeper(s) will then take these work orders and complete the Prioritization and completion and schedule start dated. Any additional parameters that are required for the Planner should be addressed before forwarding – dates, and cost thresholds if required should be noted
	CM 2.08	Change WO Status to 04 Approved for Planning	Promote for planning
Maintenance Planner	CM 3.01	Wo Planning Sub Process	
	CM 3.02	Is Approval Required	If dates or cost are identified on the work order from the Gate Keeper(s), that the planner estimate is difference, or dates cannot complete to - Change to Status 11 to request the proper approver level
	CM 3.03	Change WO to Waiting for Approval	Change to Status 11
	CM 3.04	Does Work Require a Shutdown	
	CM 3.05	Change to Waiting Plant Condition	If yes to CM 3.04 - Change this order to “Waiting Plant Condition” – these jobs should be cross referenced with the short term planning and shut down requirements to verify that these jobs will make the completion date required
	CM 3.06	Is WO Requested Completion Date Still Good	If no to CM 3.04 – Can completion dates be met
	CM 3.07	Update WO Notes and Change to Status 01	If no to CM 3.06 – Update notes and resend back to Status 01 for recycling to Gate Keeper(s).
	CM 3.08	Change WO – Waiting Scheduling	If yes to CM 3.06 – change order to Waiting Scheduling

Role	Step ID	Step Title	Step Description
	CM 3.09	Maintenance Scheduling Process	

Business Process – Corrective Emergency

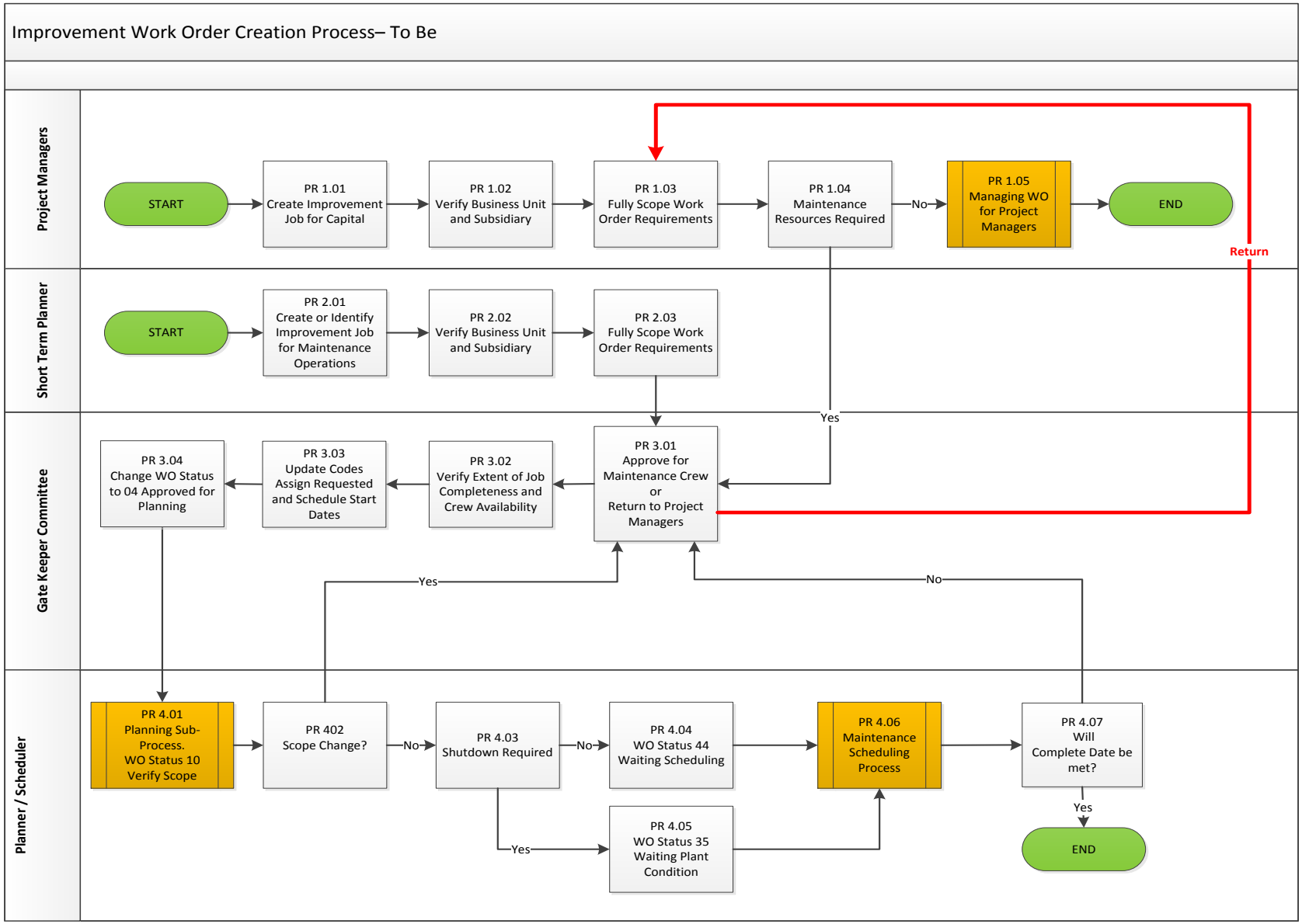


Role	Step ID	Step Title	Step Description
Overview			
WO Originator	ER 1.00	Problem Found - Immediate Need For Maintenance Resources Identified.	
	ER 1.01	Create Work Request In CMMS At Status 01 – Work Request Awaiting Review. Assign Preliminary Emergency Priority.	
	ER 1.02	During Or Outside Of Normal Office Hours?	• Outside of Normal Hours – proceed to ER 2.00 • During Normal Hours – proceed to ER 4.00
On Call or Shift Emergency Approval	ER 2.00	Identify Activity To Mitigate Immediate Consequences Of Failure	One of the considerations for deeming an event is an emergency is; are there step required to mitigate this event that makes this not an emergency. Where operational steps can be taken to remove the risks for – safety, environmental, or production issues, is one of determining factor for deciding if "Call In" is required.
	ER 2.01	Call In Needed Maintenance Help	Where risks still exist after Mitigation, call in may be required
Operations	ER 3.00	ER 3.00 Prepare for called in resources through additional troubleshooting and/or work protection.	Operations should still act towards quick resolution of this emergency, additional readiness and monitoring of this even should it escalate into a larger problem. Examples would be • Lock out / Tag out, and procedure documents (where shut down is required) • Area clean up or clearing for the repair • Where applicable de-rate current equipment, move load to standby equipment

Role	Step ID	Step Title	Step Description
	ER 3.01	Change Wo Status To 49* – Emergency Break In	
Maintenance Planner	ER 4.00	Approve Or Reject Work Orders At Status 49	During normal office hours – these escalated orders still need to be verified with the Gate Keeper(s).
	ER 4.01	Cancel Work Order – Change To Wo Status 91	For Duplications, where work order is not valid, or where assessment does not find an emergency event.
	ER 4.02	Identify Activity To Mitigate Immediate Consequences Of Failure	One of the considerations for deeming an event is an emergency is; are there step required to mitigate this event that makes this not an emergency. Where operational steps can be taken to remove the risks for – safety, environmental, or production issues, is one of determining factor making this a status 49 work order.
	ER 4.03	Change WO Status To 49* – Emergency Break In	
	ER 4.04	Break Into Weekly Maintenance Schedule To Perform Mitigation Activities	The jobs that are marked as Emergency will need to go to immediate schedule, or break in work. This will affect the current schedule and therefore scheduler will need to be notified as to adjust the current schedule to offset the time that these new work orders displace.
	ER 4.05	Work Order Execution Sub-Process	
	ER 4.06	Is The Immediate Problem Fixed Permanently?	If complete – proceed to ER 5.00 If more work is required or if initial risks or criticality has been removed – proceed to 6.00

Role	Step ID	Step Title	Step Description
	ER 5.00	Work Order Execution Sub-Process. Complete And Close	
	ER 5.01	Scheduling Sub-Process – Schedule Compliance Reporting.	At end of current period run Schedule Compliance Report to see impact of displaced work order due to Emergency events
	ER 6.00	Work Order Prioritization Sub-Process	With mitigation or temporary fix in place – resend work order through the priory sub process to manage the new priority it reflects.
	ER 6.01	Update Codes, BU, & Assign Completion Date & Scheduled Start Date, Describe Work Scope	Update any of the pertinent fields due to first mitigation.
	ER 6.02	Change Wo Status To 04 – Approved For Planning	If additional planning to make this a permanent fix is required send these jobs back through >Planning>Scheduling sub processesa
	ER 6.03	Work Order Planning Sub-Process	

Business Process – Improvement Work Order

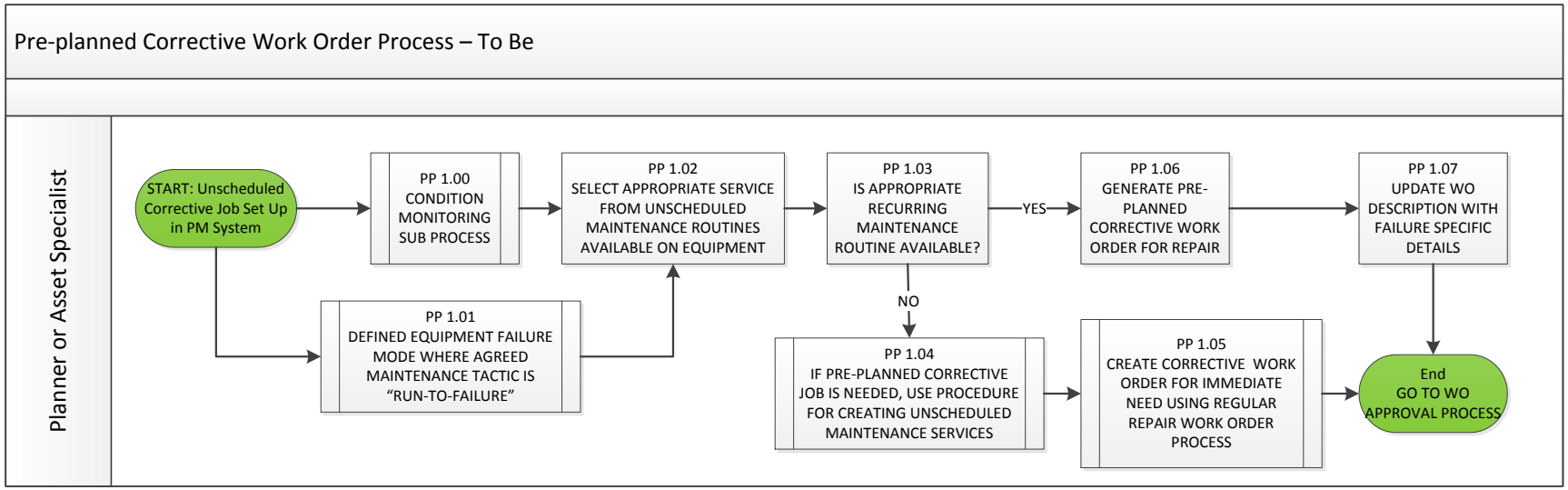


Role	Step ID	Step Title	Step Description
Overview			Improvement jobs can be broken up into two categories, Managed by Maintenance and one for Capital Managers. • Maintenance will look at the upcoming work and bundle these up to create an Improvement project for managing large group or large amount of monetary spending that they want to manage. Example would be large rebuilds • Capital Managers – normally for new or large replacements, and work off of the long term Plan for Asset Replacements or System Upgrades, Our proposal is that for all Improvement jobs that they follow the job cost model and are manage similar.
Project Managers	PR 1.01	Create Improvement Job for Capital	Forward proper applications/forms for Project job to be created
	PR 1.02	Verify Business Unit and Subsidiary	Make sure that the WBS is reflected in the chart of accounts to support your Project type
	PR 1.03	Fully Scope Work Order Requirements	Fully scope for estimation purposes and for the creation of the detail contracts the work orders required for the WBS
	PR 1.04	Maintenance Resources Required	If Maintenance Resources are required forward the appropriate work order to the maintenance Gate Keeper(s) for verification of completion date and Labour loading required. – Proceed to PR 3.01 If not proceed to PR 1.05
	PR 1.05	Managing WO for Project Managers	It will be the responsibility of the Project Managers or their delegate to manage and complete and close the work orders for their project
Short Term Planner	PR 2.01	Create or Identify Improvement Job for Maintenance Operations	Forward proper applications/forms for Project job to be created

Role	Step ID	Step Title	Step Description
	PR 2.02	Verify Business Unit and Subsidiary	Make sure that the WBS is reflected in the chart of accounts to support your Project type
	PR 2.03	Fully Scope Work Order Requirements	Fully define the work order requirements for the creation of the detail work orders required for the project WBS
	CM 2.08	Change WO Status to Approved for Planning	Forward to Gate Keeper(s) for approval for panning
Gate Keeper(s)	PR 3.01	Approve for Maintenance Crew or Return to Project Managers	The Gate Keeper(s) will verify the Labour loading and required date. If maintenance crew is not available or if dates cannot be met, these will be back to the Project Managers for external resources and control.
	PR 3.02	Verify Extent of Job Completeness and Crew Availability	If work order has enough information and will be received to be done by the Maintenance crew they will proceed
	PR 3.03	Update Codes Assign Requested and Schedule Start Dates	
	PR 3.04	Change WO Status to Approved for Planning	
Planner / Scheduler	PR 4.01	Planning Sub-Process. WO Status Verify Scope	Once Planner receive these new work request he/she will put these job through the planning process

Role	Step ID	Step Title	Step Description
	PR 402	Scope Change?	If scope has been change after the detail planning has been done – send back to Gate Keeper(s).
	PR 4.03	Shutdown Required	If a shutdown is required move to status 35 If a shutdown is not required move to status 44
	PR 4.04	WO Status 44 Waiting Scheduling	
	PR 4.05	WO Status 35 Waiting Plant Condition	
	PR 4.06	Maintenance Scheduling Process	Align these planned jobs with the Scheduling Process
	PR 4.07	Will Complete Date be met?	If dates cannot be met – send back to Gate Keeper(s)

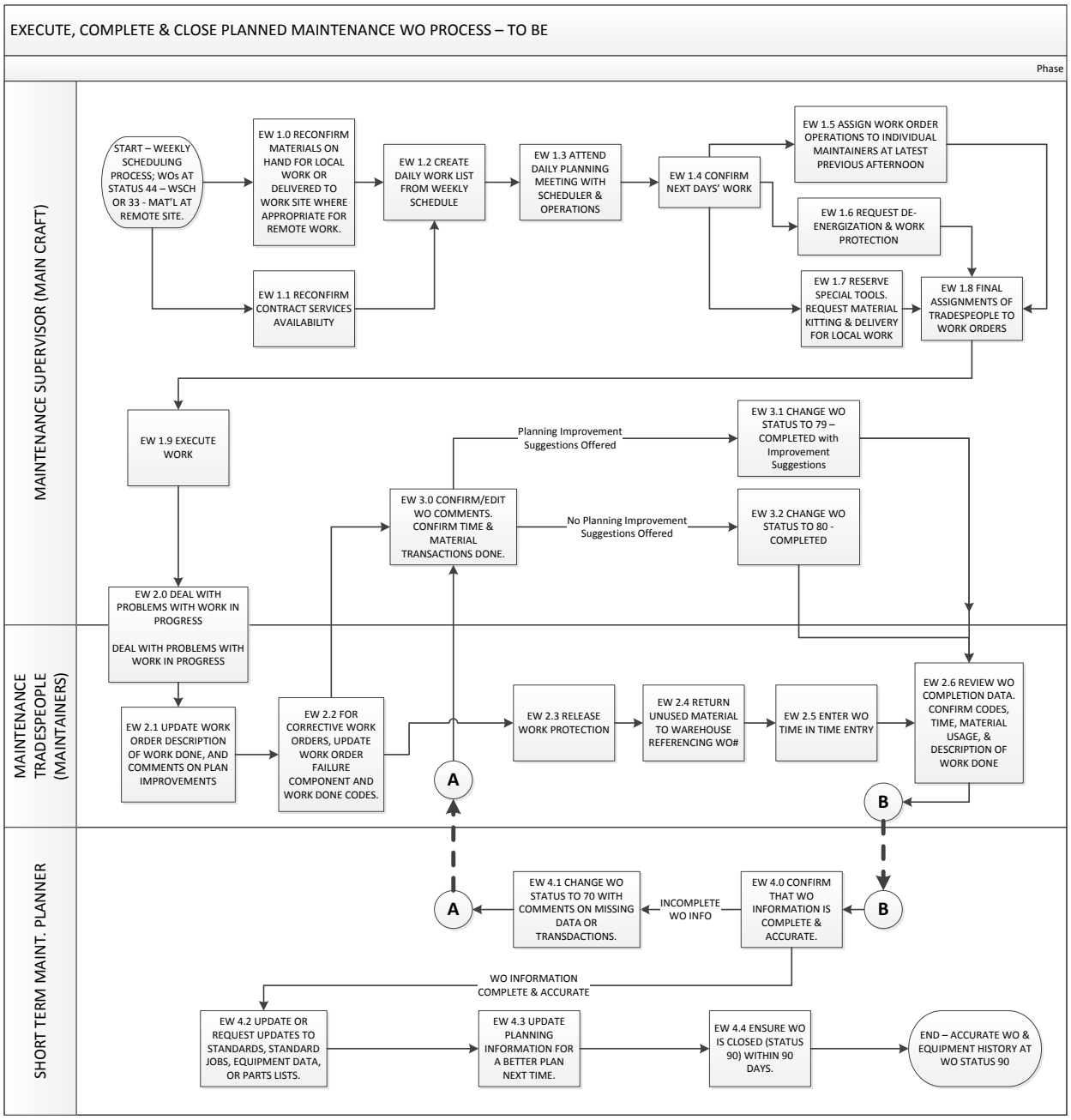
Business Process – Pre-Planned Repair



Role	Step ID	Step Title	Step Description
Overview			At any time there is the ability to create template or model jobs, for the requirements for work that are not metered or calendar event. These can be generated from either the Condition Monitoring or from a list of Planned but Unscheduled events. These jobs can be fully scoped but awaiting a condition that is expected to happen within the life of an equipment. • Vibration • High Heat • Oil Analysis • Total breakdown • System Shutdown These jobs are a simple way to generate a fully planned job, for the condition of equipment, to eases the burden of having to go through an extensive planning stage.
Planner or Asset Specialist	PP 1.00	Condition Monitoring Sub Process	Assess the results from that condition monitoring system you are using. Possibility for inbounding or feeding or results to condition Monitoring
	PP 1.01	Defined Equipment Failure Mode Where Agreed Maintenance Tactic Is "Run-To-Failure"	This is a strategic step in determining the Maintenance strategy site is working to. It is from this strategy that a site will determine what degree of maintenance they will do.
	PP 1.02	Select Appropriate Service From Unscheduled Maintenance Routines Available On Equipment	Once set up, you will be presented with a list of jobs that can be generated for an equipment record.

Role	Step ID	Step Title	Step Description
	PP 1.03	Is Appropriate Recurring Maintenance Routine Available?	
	PP 1.04	If Pre-Planned Repair Job Is Needed, Use Procedure For Creating Unscheduled Maintenance Services	If the appropriate Model does not exist, assess the requirement if this is a reoccurring event. If required assess the need of creating a model job and assigning this to the equipment.
	PP 1.05	Create Corrective Work Order For Immediate Need Using Regular Corrective Work Order Process	If no job exists – create a standard repair job, track the results to assist with the creation of the model job
	PP 1.06	Generate Pre-Planned Corrective Work Order For Repair	
	PP 1.07	Update Wo Description With Failure Specific Details	Complete the failure assessment on the generated job.

EXECUTE, COMPLETE & CLOSE PLANNED MAINTENANCE WO PROCESS



Role	Step ID	Step Title	Step Description
MAINTENANCE SUPERVISOR (MAIN CRAFT)	EW 1.0	RECONFIRM MATERIALS ON HAND FOR LOCAL WORK OR DELIVERED TO WORK SITE WHERE APPROPRIATE FOR REMOTE WORK	Don't waste Maintainers' efficiency by assigning them planned work where the material is not ready or available.
	EW 1.1	RECONFIRM CONTRACT SERVICES AVAILABILITY	If the contract service is being run by the Maintenance Front Line Supervisor or Work Execution Manager, then ensuring the presence of the contractor when needed is under Work Execution's control. Coordinate with the person responsible for the contract to ensure efficient execution.
	EW 1.2	CREATE DAILY WORK LIST FROM WEEKLY SCHEDULE	The Weekly Schedule is prepared by the Scheduler, and represents a best guess of the sequence of work. While there are probably some "anchor jobs" on the schedule that cannot be moved around without major consequences, the Maintenance Supervisor is responsible to prepare the daily work lists, assign Maintainers to various jobs, and coordinate with other maintenance supervisors and Operations as required for the efficient and timely execution of the schedule.
	EW 1.3	ATTEND DAILY PLANNING MEETING WITH SCHEDULER & OPERATIONS	This meeting can be formal or informal. The intent of this activity is to ensure coordination for efficient use of resources and release of equipment for maintenance.
	EW 1.4	CONFIRM NEXT DAYS' WORK	Since the weekly schedule does not represent the final word on what jobs will be done each day, the outcome of the daily coordination meetings is the list of work to be performed the next day.
	EW 1.5	ASSIGN WORK ORDER OPERATIONS TO INDIVIDUAL MAINTAINERS AT LATEST PREVIOUS AFTERNOON	Work Orders should be assigned to individual Maintainers the previous day, to avoid start delays and encourage preparation.
	EW 1.6	REQUEST DE-ENERGIZATION & WORK PROTECTION	Requests for equipment isolation and testing should be prepared for the confirmed work for the following day, in order to get equipment isolated and de-energized on night shift and avoid delays awaiting permits.
	EW 1.7	RESERVE SPECIAL TOOLS. REQUEST MATERIAL KITTING & DELIVERY FOR LOCAL WORK	Storekeepers need some time to kit and deliver (bag and tag) work order material. There needs to be sufficient time allowed after confirming the next days' work schedule to let the Storekeepers perform this task. Do not have material delivered too many days in advance to avoid losses and clutter.
	EW 1.8	FINAL ASSIGNMENTS OF TRADESPEOPLE TO WORK ORDERS	Maintainer assignments may change depending on what break in work appears and unforeseen leave.
	EW 1.9	EXECUTE WORK	
	EW 3.0	CONFIRM/EDIT WO	In order to achieve accurate maintenance history and costs, the

Role	Step ID	Step Title	Step Description
		COMMENTS. CONFIRM TIME & MATERIAL TRANSACTIONS DONE.	transactions and comments entered against the work order must represent what was done. The necessary fields on the work order, such as Failure Codes, should be filled completely.
	EW 3.1	CHANGE WO STATUS TO 79 – COMPLETED with Improvement Suggestions	If there was new information researched (i.e. parts, clearances, torques) or if there are other improvements to the job plan desired for the next time, they should be entered on the work order. This new status is a trigger for the Planner to review the Work Order and make the appropriate improvements to standard jobs and equipment data.
	EW 3.2	CHANGE WO STATUS TO 80 - COMPLETED	Changing the status to 80 assigns a Completion Date to the work order and if the job is a PM, resets the PM Schedule.
	EW 2.0	DEAL WITH PROBLEMS WITH WORK IN PROGRESS	In the execution of the work, best practice is that the Maintenance Supervisor and Maintainers deal with any issues that come up and inter-trade coordination rather than involving the Planner. The exception to this practice is when the work cannot be accomplished at all.
MAINTENANCE TRADESPEOPLE (MAINTAINERS)	EW 2.0	DEAL WITH PROBLEMS WITH WORK IN PROGRESS	See EW 2.0 under Maintenance Supervisor group
	EW 2.1	UPDATE WORK ORDER DESCRIPTION OF WORK DONE, AND COMMENTS ON PLAN IMPROVEMENTS	It is important to get feedback directly from the Maintainers on what was done and the problems encountered in the performance of the work. This improves the accuracy and usefulness of the work order history. The comments “Work Done” and “Completed” are usually inadequate. The description of work done should match the transactions entered against the work order.
	EW 2.2	FOR CORRECTIVE WORK ORDERS, UPDATE WORK ORDER FAILURE COMPONENT AND WORK DONE CODES.	The Failure Codes need to be updated by the Maintainer and later confirmed by the Maintenance Supervisor (Refer to EW 3.0).
	EW 2.3	RELEASE WORK PROTECTION	
	EW 2.4	RETURN UNUSED MATERIAL TO WAREHOUSE REFERENCING WO#	Unused stock items need to be returned to the warehouse with instructions to return the quantities to the correct work orders. Unused direct purchased material should be returned to Salvage Stores for investment recovery. Avoid clutter and unofficial inventories.
	EW 2.5	ENTER WO TIME IN TIME ENTRY	The time spent performing the work needs to be recorded against the work order. Work Order time is only that spent working on the work order. Time entry against individual work order routing steps for planned jobs is encouraged in PAAR Level 1 and required in PAAR Level 2.
	EW 2.6	REVIEW WO COMPLETION DATA. CONFIRM CODES, TIME, MATERIAL USAGE, &	The Maintainer is the first line of quality control to ensure that work is documented accurately.

Role	Step ID	Step Title	Step Description
		DESCRIPTION OF WORK DONE	
SHORT TERM MAINT. PLANNER	EW 4.0	CONFIRM THAT WO INFORMATION IS COMPLETE & ACCURATE.	
	EW 4.1	CHANGE WO STATUS TO 70 WITH COMMENTS ON MISSING DATA OR TRANSDACTIONS.	Status 70 is "Completed – Awaiting Information" is used when Work Order Information is deemed to be incomplete. The responsibility to correct that condition rests with the Maintenance Supervisor.
	EW 4.2	UPDATE OR REQUEST UPDATES TO STANDARDS, STANDARD JOBS, EQUIPMENT DATA, OR PARTS LISTS.	If work order information is complete and accurate, and there are learnings that should be captured for next time, the Planner is responsible to make or request those changes.
	EW 4.3	UPDATE PLANNING INFORMATION FOR A BETTER PLAN NEXT TIME.	The Planner updates the JDE Standard Jobs and Equipment data to improve the knowledge in the system of how to perform the work.
	EW 4.4	ENSURE WO IS CLOSED (STATUS 90) WITHIN 90 DAYS	A report will run automatically to close work orders 90 days after completion. The Planner will check periodically to ensure that this is getting done.

RACI Chart for Work Order Activities

Tasks	Equipment Operator	Long Term Asset Planner	Maintenance Technician	Maintenance Supervisor		Maintenance Short Term Planner	Gate Keeper(s)	Asset Owner	Work Execution Manager	Asset pec-ialist/ Plant Engineer
Create Work Order	R		R						A	
Review WO Codes & Accounting Accuracy							R		A	
Review & Approve WO Scope							R		A	
Assign Requested Completion Date				C			R	C	A	C
Assign Rough Cut Requested Start Date		C					R		A	
Assign Requested Start Date		C				R			A	
Input Problem Code	R		R					A		
Input preliminary Component Code						R			A	C

Tasks	Equipment Operator	Long Term Asset Planner	Maintenance Technician	Maintenance Supervisor	Stores	Maintenance Short Term Planner	Gate Keeper(s)	Asset Owner	Work Execution Manager	Asset Spec-ialist/ Plant Engineer
Input or confirm Component Code			R	A						
Input "Work Done" Code and text description			R	A						
Plan Labour						R			A	
Plan Materials & Services						R			A	
Create Purchase Requisitions for Planned Material						R			A	
Arrange for Inventory Material to be On Hand at Warehouse					R				A	
Receive & Store Purchased Material					R				A	

Tasks	Equipment Operator	Long Term Asset Planner	Maintenance Technician	Maintenance Supervisor	Stores	Maintenance Short Term Planner	Gate Keeper(s)	Asset Owner	Work Execution Manager	Asset Specialist/ Plant Engineer
Coordinate with Contractors for Services mobilization				R					A	
Feedback Data & Plan Improvements to Planner				R					R	
Complete Work Order			R						A	
Initial WO QA check				R					A	
Update Equipment Data & Standard Job Plans						R			A	
WO QA Check						R			A	
WO Close Out				C		R			A	
Analyze Failures or Failure trends		I		C				C	A	R
Maintenance Strategy Adjustments		R	I	C				A	C	C

Tasks	Equipment Operator	Long Term Asset Planner	Maintenance Technician	Maintenance Supervisor	Stores	Maintenance Short Term Planner	Gate Keeper(s)	Asset Owner	Work Execution Manager	Asset Specialist/ Plant Engineer
Implement new Maintenance Strategies		C	I	I		R		A	I	C

Responsible: The "Doer"

Accountable: The person responsible for ensuring it gets done.

Consulted: Opinions requested

Informed: Told about it after the fact.

Newfoundland & Labrador Hydro
Group of Companies

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HYDRO
THE POWER OF COMMITMENT

CHURCHILL FALLS
(LABRADOR) CORPORATION LIMITED
A HYDRO GROUP COMPANY

WORK EXECUTION

Overview

What is it and why is it an important part of Work Management?

People Powered Performance

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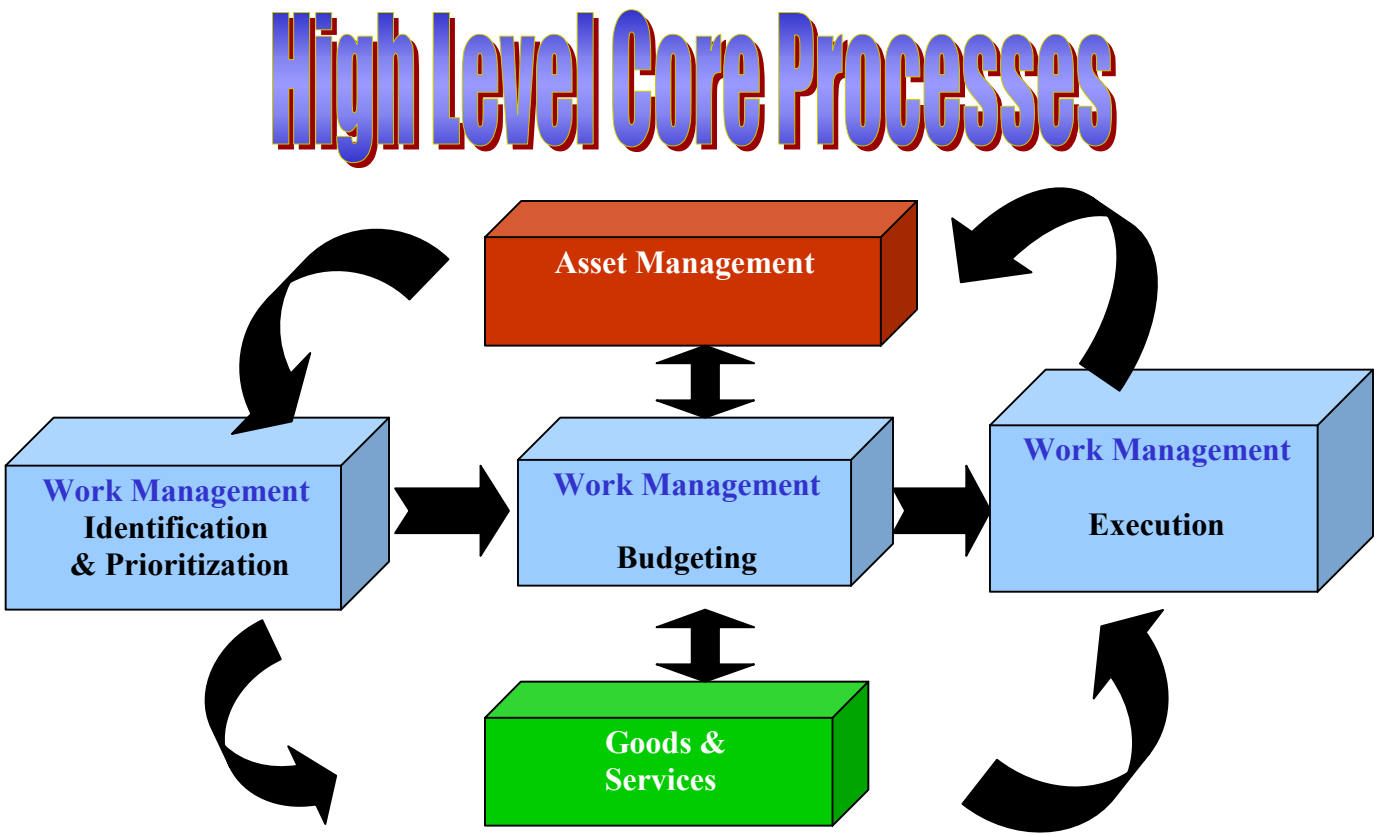
Work Management

Work execution is one of three components making up the work management process. A work management process is a method by which work is identified, selected, prioritized, budgeted, planned, coordinated, scheduled and executed.

The Hydro Group of Companies has further defined the Work Management process into the following:

1. Work Identification and Prioritization (WI&P) Process
2. Work Budgets Process
3. Work Execution Process

Figure 1: High Level Core Processes



Work Identification and Prioritization (WI&P) Process

The purpose of this part of the Work Management Process is to identify, evaluate and prioritize work to ensure that the work funded by the Hydro Group of Companies is aligned with the corporate strategic plan and matched to available financial resources. More specifically the process will take incoming proposals, needs and requirements, screen them based on high level strategic/business value, develop work estimates/projections (i.e., material, labour, costs, and person-hours, etc.) and deliver all future approved work requirements into the Work Budgets process. Projects and initiatives will be ranked and prioritized at a departmental level and eventually, at a cross-divisional level. This corporate prioritized work listing will be balanced to match financial resources and then delivered to the work budgets process for development of future plans.

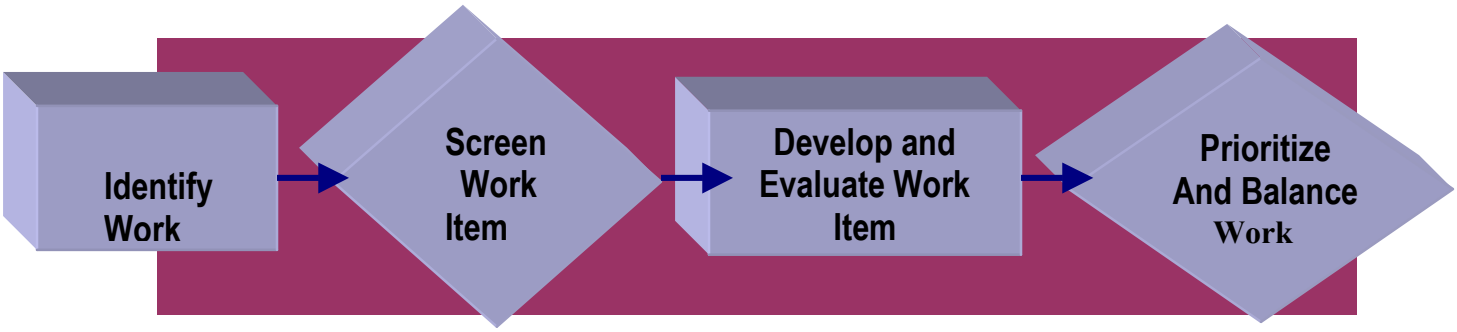


Figure 2: WI&P Process Overview

Work Budgets Process

The purpose of this part of the Work Management process is to provide all parties within the Hydro Group with the information to properly schedule and budget work efforts. Through the consolidation of information from many sources, this process will provide the following deliverables:

1. Master Work Plan and Schedule
2. Master Resource Plan and Budget
3. Master Procurement Plan and Budget
4. Financial Budget
5. Communications Plan

The Work Budgets process will gather and consolidate information used in the Master Work Schedule, Resource Schedule, Procurement Plan and Financial Budget. The information will be reviewed identifying and communicating all instances when demand exceeds available resources. The process will facilitate negotiation of any identified conflicts. Changes and updates resulting from the negotiation will be incorporated into the appropriate schedules and plans. An internal review of the proposed schedules and budgets will be performed offering a last point of resolution for any outstanding conflicts. Final external review and approval of the financial budgets will trigger the communication of approval for all schedules and budgets to the Work Execution process.

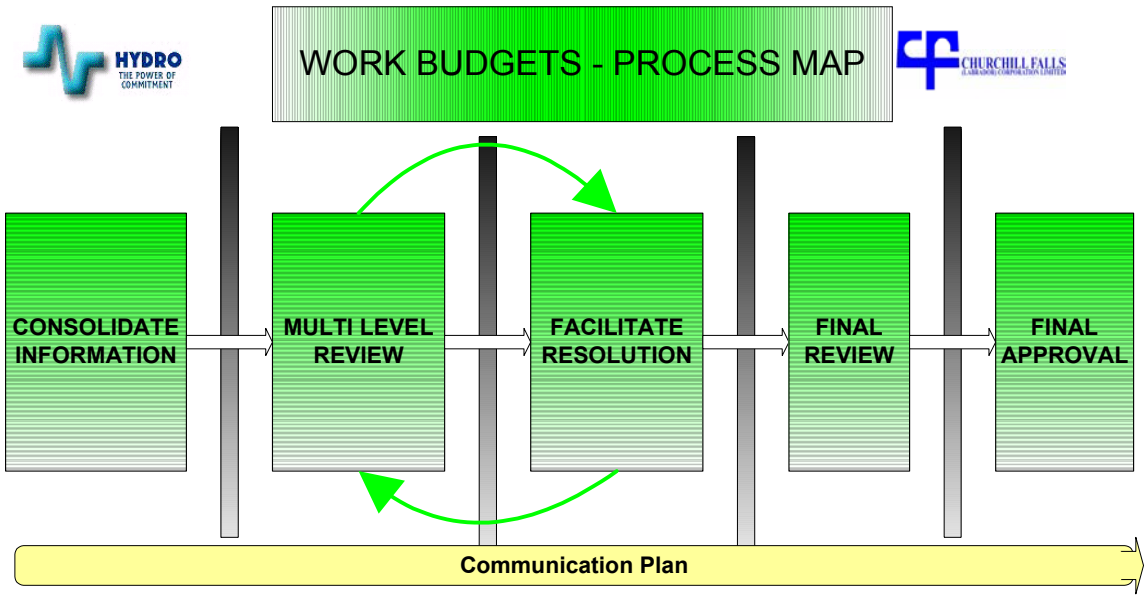


Figure 3: Work Budgets Process Overview

Work Execution Process

1. PURPOSE:

The purpose of this part of the Work Management process is to provide an effective and efficient means to properly manage the execution of work; more specifically the five work plan types approved in the work budget process. This process is designed primarily to handle work of which there is sufficient time to plan and schedule. However, there are provisions to handle emergency and urgent work as well. The process was designed realizing that it's not logical or economical to plan all work to the same degree and as a result the process contains guidelines to help determine the degree of planning work should receive. The process is intended to provide a means through which quality work can be performed on schedule at least cost.

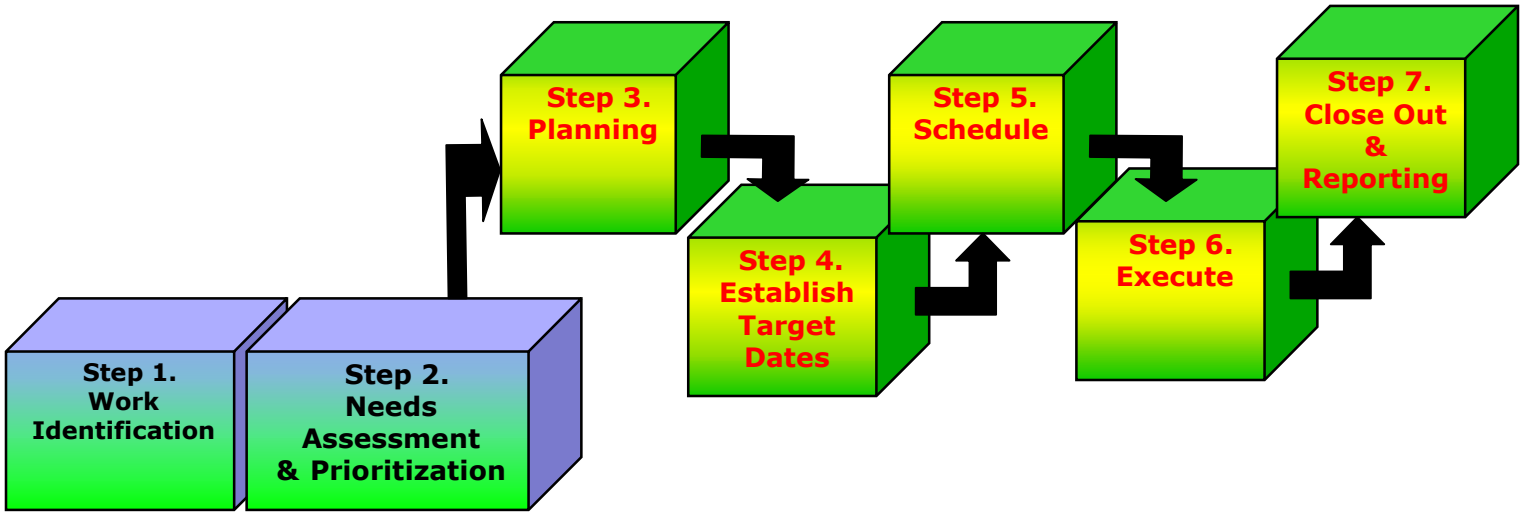


Figure 4: Work Execution Process Overview

2. OBJECTIVES:

One of the strategic goals of The Newfoundland and Labrador Hydro Group of Companies is to "Optimize the Performance of our Employees". The primary objective of the Work Execution Process is to increase employee productive time by reducing waste time thereby making the most efficient use of resources in the execution of work. To meet this objective the company had to:

1. ***Define and map an effective and efficient Work Execution Process.***
2. ***Define and communicate the roles of all process participants.***
3. ***Identify/establish lines of communication within the process.***
4. ***Provide adequate measures to monitor progress and promote accountability.***
5. ***Establish and communicate work priority definitions.***
6. ***Establish means for storing standard job plans for repetitive jobs.***
7. ***Identify and provide tools to support the process.***
8. ***Provide necessary process training.***

Some of these objectives were determined from a root cause analysis of the issues and concerns documented as a result of surveys, questionnaires and interviews done across the Hydro Group of Companies. Other objectives were a result of interviews and visits to other companies to see what they do. The lessons learned both internally and externally were incorporated in the objectives.

3. BENEFITS:

1. ***Increased productive time by reducing delays.***
2. ***Improved utilization of human and physical resources.***
3. ***Formal documented Work Execution Process for the Hydro Group of Companies.***
4. ***Clear definition of Roles and Responsibilities for participants.***
5. ***Improved lines of communication between stakeholders.***
6. ***Metrics to allow performance measurement.***
7. ***Ownership of outages to provide better utilization.***
8. ***Improved management of work through a consistent approach to work prioritization.***

4. PROCESS OVERVIEW (BASIC CONCEPTS):

The Newfoundland and Labrador Hydro Group of Companies performs work that generally involves either routine or project work. Routine work is ongoing and to some degree repetitive and is work normally done to sustain the business. Routine work consists of corrective, preventive, non-maintenance and some small capital work such as service extensions and distribution system upgrades. Project work is normally a means to respond to those requests that cannot be addressed within the organization's normal operational limits. Project work is work performed on assets on a one time or infrequent nature. Projects will be categorized as either capital or operating. Separate process flow charts have been developed for both routine and project work.

The redesigned process involves a seven-step process from the time work is identified until close out and reporting:

1. Work Identification
2. Needs Assessment and Prioritization

(WIP) Guidelines

---

3. Planning
4. Establishing/Confirming Target Dates
5. Scheduling
6. Executing the Work.
7. Closeout and Reporting

(WE) Process

Work Identification

- Any employee or stakeholder can identify work**.**

Needs Assessment and Prioritization

- All work has to be assessed to see if its meets value added criteria and needs assessment criteria as defined in Work Identification and Prioritization Process.

- Work that passes through the WI&P Criteria has to be prioritized. The priority definitions for routine work were developed as part of the Work Identification & Prioritization Process and will be used as guides to Work Execution. Project work will be assigned relative priorities ranked in order of most too least important.

Planning

- Work order planning is a major strategy to improve maintenance efficiency with regard to unproductive maintenance time. Planning guidelines and considerations have been developed as part of this process. Planning involves many considerations such as clarifying /developing scope, estimating labor by craft, identifying parts and material, developing schedules, identifying/arranging outages, etc.

Establishing/Confirming Target Dates

- When the work order plan is complete and final approval given, it's ready to be acted on. Based on priority, delivery of parts and services, manpower availability, outage availability, etc., target dates are established. Again, valuable time should not be spent determining target dates for low priority work. Parts, services, etc. are arranged based on target date. When all conditions have been established, the work order is moved to waiting to be scheduled backlog (status 44).

Scheduling

- Scheduling is the step in the process where the planner moves work to a weekly schedule based on priority, craft hours available, target start dates, outage availability, etc. The degree of compliance with the weekly schedule is a primary measure of how well the process is working. Plan your work and work your plan.

Execute the Work

- At this stage the supervisor assigns individual work orders to the employees for execution. Employees are expected to follow the plan and supervisor is expected to monitor progress to complete work on schedule, on budget. Any deficiencies or problems encountered with the plan after the work has started are to be handled by the supervisor or the trade's people. Emergency type work is also handled by supervisor and trades people in the same manner.

Close Out and Reporting

- When the work is complete, all applicable reporting must be done. Close out normally involves describing the actual work performed, retiring/ disposing/adding new assets, reviewing/ modifying/saving work plans, providing feedback to planners, reviewing schedule, budget and quality performance and doing a post implementation review.

5. SCOPE:

a) ***Begins With: Begins with approved work budgets including Master Work Plan and Schedule, Master Resource Plan and Budget, Master Procurement Plan and Budget, Communications Plan and Corporate Budget.***

b) Includes: Identification, Needs Assessment & Prioritization, Planning, Establishing Target Dates, Scheduling, Execution, Closing Out & Reporting of Work of the five work plan types.

Also includes specifications/justification of any required software, tools, or other enablers to support the process.

c) Excludes: Development and acquisition of technology enablers and activities falling within the Asset Management Process, Goods & Services Process, Work Identification & Prioritization Process and Work Budgets Process.

d) Ends With: Completion of quality work on time at least cost.

6. CRITICAL SUCCESS FACTORS:

1. Executive Management Commitment/Involvement through re-enforcement, support and process improvement targets.

2. Departmental Ownership and Commitment from all process participants. Take it, use it and improve it.

3. Initial and follow-up training/communication of process to all participants.

4. Promotion of a proactive maintenance environment versus a reactive maintenance environment.

5. Adherence to priority definitions. Ensure that when we are doing reactive work that it is “Real” Emergency Work. Remember unplanned work activities cost three times as much as planned.

6. Development and communication of Roles of all participants.

7. Continuous Improvement of Process.

8. Measures to monitor progress, promote accountability, and chart improvement.

7. INTERFACES & DEPENDENCIES ON OTHER PROCESSES:

Work Identification and Prioritization

The day-to-day execution of work can lead to the identification of other work items for future project work or work plan initiatives. Project work or initiatives for consideration in future work plans and identified within the Work Execution Process will be input to the WI&P process. New project work to be fast tracked for execution in the current year or current year project work that requires major changes will be routed through WI&P processes and later through work budgets to determine impact.

The Work Execution process will utilize the same evaluation criteria used to determine need and work priorities as outlined in the WI&P process. The WI&P Process Improvement Team has developed guidelines for use with the routine workflow.

Work Budgets

The Work Budget Process provides a masterwork plan and schedule, master resource plan and budget, master procurement plan and budget, financial budget and communication plan as inputs to Work Execution Process.

New project work to be fast tracked for execution in the current year or current year project work that requires major changes will be routed through WI& P processes and later through work budgets to determine impact.

Goods and Services

The day-to-day execution of work will require interaction with other processes. The most obvious of these is the goods and services process. The availability of materials and services to do work is just as important as the availability of labour. Through good planning we will identify our material requirements in advance allowing enough lead time for the delivery of materials and services before work is scheduled to start. In order to be successful the goods and services process must provide a means to communicate the availability of materials and lead times required for inventory items not in stock. Long-term work plans will allow for long term material plans, less stock outs and fewer scheduling delays due to material shortages. Work Execution will provide Materials Management with realistic advanced target start dates to ensure timely delivery of Goods and Services. Goods and Services will provide Work Execution with follow up information on material delivery dates. In urgent and emergency situations the Goods and Services Process will allow for immediate materials procurement.

Asset Management

The execution of work especially capital projects will result in the addition of new equipment and the retirement or relocation of others. The asset record management process provides for adding, disposing, retiring, transferring or refurbishing an asset. The work execution process has provided inputs necessary in keeping the asset records updated.

Proper coding and reporting to work orders is also required to ensure the correct maintenance costs are recorded to the asset record.

Contract Management

The execution of work especially with regard to projects will sometimes require the management of contacts. Utilization of the contract management process to manage work by outside sources is not within the scope of work execution but is required in the overall work management process.

8. AN IMPORTANT PART OF WORK MANAGEMENT

From this overview of the work execution process you should have learned the answers to the following questions. Define The Work Execution Process? What is included in the scope of the Work Execution Process? What part does The Work Execution Process have in the Work Management Process?

What is The Work Execution Process? What is included in the scope of The Work Execution Process?

A process used to safely complete quality work on schedule at least cost. The process includes seven (7) steps:

1. **Work Identification**
   Requested work activities and equipment deficiencies are clearly described so the scope, significance, and need can be evaluated.

2. **Needs Assessment and prioritization**
   Work requests are screened and approved based on value to the company.

3. **Planning** Determine the best way to minimize wasted time during jobs by ensuring all required resources including materials, tools, and labour are identified.

4. **Establishing Target Dates**
   Realistic target dates are established with consideration given to the master work plan schedule, resource availability, coordination among participating departments, impact on equipment and/or system security, impact on operations, impact on customers, etc.

5. **Scheduling**
   Develop a weekly schedule that attempts to assign work from a planned backlog for every available craft hour based on a forecast of required hours with a goal to minimize wasted time between jobs.

6. **Execute The Work**
   Work is implemented and controlled in accordance with the plan, the schedule, the safety and health program and the environment program. The supervisor handles the current day's work and problems.

7. Closeout and Reporting

Close out normally involves describing the actual work performed, retiring/disposing/adding new assets, reviewing/ modifying/saving work plans, providing feedback to planners, reviewing schedule, budget and quality performance and doing a post implementation review.

What part does The Work Execution Process play in the Work Management Process?

The maximum value of the Work Execution process will be realized when the two front end parts of the Work Management process, WI&P and Work Budgets, successfully deliver approved budgets, master schedule, and resource plan for the five work plan types, 8 to 9 months in advance of the year of execution. This will allow the planning and scheduling components of the work execution process to become more effective. Effective planning and scheduling will reduce and in many cases eliminate many of the typical work interruptions, consequently being a factor in the performance of quality work completed on time at least cost.

Plan the work and work the plan. Weekly schedule compliance will ultimately be an indicator of how well we have done with working the plan. Although the work execution process has provisions for reactive jobs, it will be of little value to a business that is content to be in a reactive mode. The Hydro Group of companies strives to be a proactive company and thus should reap the benefits of the work execution process. Industry averages indicate that reactive maintenance activities cost three times as much as jobs that are planned and scheduled. The amount of work accomplished will rise as delays are reduced.

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Routine Work Process Flow Chart

Process Flow Major Activities

Work Identification		
No.	**Name**	**Description**
1	Work Identified	Work can be identified by any Hydro Group employee or stakeholder. An employee has several options for requesting work. • Input request electronically to JD Edwards • Submit a written work request • E-mail • Phone • Verbal External stakeholders normally make their requests through: • E-mail • Phone All work requests, regardless of communication media, will be input to JD Edwards Maintenance Module for processing as per steps outlined in process flow chart.

Needs Assessment & Prioritization		
No.	**Name**	**Description**
2	Assess Urgency	Needs assessment and prioritization of all work requests is normally the responsibility of the Asset/ Business Unit Manager. On-call or Shift Supervisors are required to assess and prioritize work requests when required. In any event, the individual responsible for prioritizing work is expected to consult with other knowledgeable employees, when required, to determine the correct prioritization (i.e. ECC, Operations, other Supervisors, etc.). Routine work, regardless of its nature, will be given a priority rating of 1 to 4 using the corporate Routine Work Prioritization Guide for evaluating and prioritizing identified day-to-day work. The intent of the

Needs Assessment & Prioritization		
No.	**Name**	**Description**
		prioritization guide is to provide an objective consistent approach to prioritizing work; it is not meant to replace good judgment or discussion of importance of work between supervisors. There may be cases where this guide is not suited. A combination of evaluation factors to produce an overall level of importance, combined with urgency, will help determine the priority of a planned piece of work. A priority calculator provided with user selectable fields will automatically calculate priority. Refer to Appendix F for details of Routine Work Prioritization Guide.
3	Initiate Work Requests for Priority 1 (Emergency Work) As Soon As Practical	When a work request has been assessed and assigned priority 1 (emergency work), it must be acted on immediately. Work of this nature normally begins with verbal authorization and prior to any formal work request being input to JDEdwards Maintenance Module. It's the responsibility of the Supervisor or designate to initiate a formal work request as soon as practical after the event has occurred. The request is required to capture cost and maintenance history against the asset, to procure parts and to serve as a record for analysis and evaluation of emergency work. Priority 1 (emergency work) is reactive work and ultimately will be measured to determine the quantity of this type of work. Excessive quantities of Priority 1 work will be analyzed to determine root causes with the intent to reduce to acceptable levels. Acceptable industry standards for reactive work is 10% or less of total hours consumed doing work. Local Management will be responsible to set targets in their area of responsibility.
4	Initiate Work Request for Priority 2 (Urgent Work)	When a work request has been assessed and assigned Priority 2 (Urgent Work), action must be taken within a seven (7) day period as outlined in the Routine Work Prioritization Guide. In cases where a formal work request has not been initiated, it will be the responsibility of the supervisor or designate to ensure a work request is generated. Although Priority 2 work is

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Needs Assessment & Prioritization		
No.	**Name**	**Description**
		considered reactive, there is normally sufficient time to do fast track planning. Priority 2 (Urgent Work) is reactive work and ultimately will be measured to determine the amount of this type of work. Excessive quantities of Priority 2 work will also be analyzed to determine root causes with the intent to reduce to acceptable levels. Acceptable industry standard for reactive work is 10% or less of total hours consumed doing work. Local Management will be responsible to set targets in their area of responsibility.
5	Initiate Work Request for Priority 3 & Priority 4 Work	Work requests for Priority 3 and 4 work orders are submitted by any employee or stakeholder for entry at status 01 (awaiting work order review) to JDE Work Order Module. Priority 3 and 4 work is proactive and in this type of work this process is specifically designed to handle. This work is considered proactive because there is sufficient time to do the needs assessment and prioritization, to plan, to establish target dates and to schedule. Metrics are developed to measure the amount of time consumed doing proactive work. Local management will be responsible to set the targets in their area of responsibility. Acceptable Industry standard is to spend 80%+ time on proactive work.
6	Review Request for Acceptance	The individual responsible to review work requests for acceptance is the Asset or Business Unit Manager. • The manager will apply/approve proper priority. • Accept or reject work request and move to status 91 (reject) with reason on W/O. Communicate reason for rejection to originator.
7	Feedback Reason for Rejection to Originator/ Department	The Asset or Business Unit Manager must communicate reason for rejection to the originator or department.
8	Approval (Scope)	The individual responsible for approving scope of work is the Asset or Business Unit Manager. • The work request at this stage contains minimal information; an asset number, asset description,

Needs Assessment & Prioritization		
No.	**Name**	**Description**
		priority and a clear description of work. • Manager or designate will approve the scope of work and move to status 04(approved in scope) to proceed in the current year of execution or defer to future years status 05 (Five Year Plan). • In cases when an Asset or Business Unit Manager does not want to see the request for financial approval, an indicator will be provided on the work order for a designate to provide financial approval.
9	Submit for Consideration in Future Years (Plan Repository)	There will be cases when work is approved in scope by an Asset/Business Unit Manager or designate but the work will not be done in the present year of execution due to constraints such as financial, labour, etc. In those cases the work request will be moved to status 05 (in Five Year Plan), for the year that it is expected to be executed. If the request is considered to be an operating or capital project, it will be returned to the Work Identification and Prioritization Process for evaluation and prioritization. This is indicated as an off page connector in the Process Flow Chart.

Planning		
No.	**Name**	**Description**
10	Minimal or Extensive Planning	The individual responsible for determining whether a work request requires minimal or extensive planning is the Planning Supervisor. • Planning Supervisor assigns code to work request indicating minimal or extensive planning • If minimal planning is required, planning will be done and work order will be moved to status 44 (WO waiting to be scheduled). • If extensive planning is required, work order will be moved to status 10 (Planning Backlog). • Minimal planning is the degree of planning applied to smaller jobs of which it is not cost effective to spend much planning time on. These

Planning		
No.	**Name**	**Description**
		jobs are normally short duration, single craft, low dollar value, of very little historical value, and while parts may be required, the parts are normally low dollar value and readily available in store or consumable bins. Examples of such work might include: • Hanging a bulletin board • Replacing a frayed electrical chord. • Tightening valve packing. Sufficient Planning for this type of work shall include: • Clear description of work • Labour estimate by craft • Parts list if required. Extensive Planning is the degree of planning applied to all other work. It might be described as larger, important, critical, and more complex pieces or work with important historical value. Extensive planning includes: • Verifying/defining scope of job • Providing labour estimates • Identifying/specifying/procuring parts • identifying/arranging special tools • Arranging outages • Developing drawings • Safety/environmental standards • Co-coordinating with other departments • Arranging transportation/accommodations • Consider customer impact/co-ordination The guidelines for minimal and extensive planning are a part of the Work Execution Process Flow and also included in the Glossary of Terms.
11	Verify/Clarify Job Scope, Identify Labour Requirements, Identify	For work requiring minimal planning, the Planner is responsible for the following: • Verify & clarify job scope/description

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Planning		
No.	**Name**	**Description**
	Parts (no ordering or reserving of parts necessary)	• Identify labour requirements by craft • Identify parts if required • Establish target date • Move work order to Status 44 (waiting to be scheduled backlog)
12	Enter into Planning Backlog	Work orders requiring Extensive Planning are moved to status 10 (Planning Backlog) with a Planner assigned. The Planning Supervisor normally assigns the Planner.
13	Extensive Planning Activity (Develop or Utilize Existing Plans)	Planners regularly review the Planning Backlog for work orders requiring extensive planning. • If the job was done before, planner will utilize the existing plans to the extent required. • A Planner may also utilize job procedures, work methods or engineering directives as part of the planning process. • The Planner will use the extensive planning guidelines in the Process Flow Chart to complete the planning. • When the plan is complete, the Planner will move it to Status 11 (awaiting Final Approval).
14	Approval (Final)	The Asset Manager/Business Unit Manager or designate is the position responsible for final approval of the work plan. The plan is considered complete at this stage and includes: • Clear scope • Labour estimates by craft • Material requirement • Tools and equipment • Procedures, drawings, etc. • Others requirements as per planning guidelines If the manager approves, the work order status will be changed to Status 14 (Final Approval for Execution).

Planning		
No.	**Name**	**Description**
15	Submit for Consideration in Future Years, Job Plan Repository (Deferral)	The individual responsible for this activity is the Asset or Business Unit Manager. • There will be cases when work is given final approval by an Asset/BU Manager or designate but decision made not to do in the present year of execution due to constraints such as financial, labour, etc. • In those cases, the W/O's will be moved to a job repository in JD Edwards (Status 05) for expected year of completion. • If the work is considered to be an Operating or Capital Project, it will be submitted to the Work Identification and Prioritization Process for evaluation and prioritization. This is indicated as an off page connection on the Process Flow Chart.
16	Feedback Reason for Rejection to Originator/ Department	The Asset Manager, Business Unit Manager or designate must communicate reason for rejection to the originator or department and move to status 91(rejected). Enter reason on W/O

Establishing Target Dates		
No.	**Name**	**Description**
18	Consideration (Material, Delivery Dates, Tools/ Equipment Availability, Etc.)	The Planner is responsible for this activity. This is the part of the process where Planners attempt to establish realistic target dates. Considerations are: • Master Work Plan Schedule • Parts/Material delivery dates (expected) • Outage requirements • Labor and Special Tools availability • Availability of Work Details (Drawings, Procedures etc) • Season/Weather • System Security • Customer Co-ordination • Operating Cost (fuel for auxiliary) • Energy Supplier Co-ordination (NUGS)

Establishing Target Dates		
No.	**Name**	**Description**
		• Service Level Agreements • Final Engineering Design Details • Co-ordination with other Departments
19	Material Required	Planner to identify any material needed to complete the work and enter on work order. Move to status 30
19A	Obtain Goods & Services	The Work Execution Process is designed primarily to handle planned work. For planned work orders, sufficient time shall be allocated for Materials Management to obtain Goods and Services. Materials Management will use target start/ completion dates applied to the work order to deliver goods and services on time. Work orders waiting for Goods and Services are tagged with Status 30 (Waiting Materials). Materials Management procure Goods and Services and move the work order to: • Status 31 (material available locally) • Status 32 (material shipped to remote site) • Status 33 (material at remote site)
20	Outage Required	The Planner is responsible to determine if an outage is required. • If an outage is required, duration of outage and tentative date must be established. This involves communication with the Energy Control Center/Operations • Outage requirement is another important consideration when establishing target start dates.
21	Flag in Backlog and prepare outage request information	Planned work orders that require outages are stored in the backlog using a plant condition code in JD Edwards work order module (Status 35, Awaiting Plant Condition). Draft Outage request at this time. • All outages on generation, transmission and distribution equipment must have the approval of the ECC/Operations or other designated Authorities. A separate process on outage management is being prepared and is intended to be delivered with the Work Execution Process.

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Establishing Target Dates		
No.	**Name**	**Description**
22	Establish Target Start & Completion Dates	Planners are responsible for establishing target start/completion dates. • When all factors that can affect target start and completion dates have been considered (i.e. parts availability, tools availability, labour availability, outage availability, etc.), the Planner will apply a realistic target start/completion date to the work order.
23	Enter into Scheduling Backlog	When all planning aspects of the work order are complete, the Planner will move the work order into the JD Edwards Backlog. • Waiting plant condition (Status 35) • Waiting to be scheduled (Status 44)

Scheduling		
No.	**Name**	**Description**
24	Develop Preliminary Weekly Schedule	Planning Supervisors and Planners in consultation with other Managers are responsible for developing Weekly Schedules. Weekly schedules are built by extracting planned work orders from the Planned Backlog (status 35- outage backlog and status 44 - planned backlog), carry over work (status 48) and standing work (status 50). The schedule will consist of a well-balanced mix of different types & priorities of work. When developing weekly schedules, Planners must consider: • Annual work plan • Outage schedule • Work order priority & start dates • Resource availability for the following week • Etc.
25	Can Schedule Considerations be Met?	This is the responsibility of the Planner. • After the preliminary weekly schedule has been built, the Planners must review individual work orders to ensure all considerations can still be met (materials, permits, resources, special tools, etc.). This is required as these work orders may have been in the planned backlog for weeks, or

Scheduling		
No.	**Name**	**Description**
		possibly months. If all considerations can still be met, the work remains on schedule.
26	Change Planned Start/ Target Completion Dates	This is the responsibility of the Planner. • If considerations can't be met, the work order is removed from the weekly schedule, new target start/complete dates applied and work order returned to the Waiting to be Scheduled Backlog (status 44) or Outage Backlog (status 35)
27	Finalize/Issue Weekly Schedule	This is the responsibility of the Planner, after sign-off by assets and labour. • When the weekly schedule is finalized, work orders are moved to Status 45 (Weekly Schedule) and issued to Frontline Supervisors and any other applicable position. • The Frontline Supervisor is responsible to become familiar with all aspects of the work and communicate schedule to department employees. • Weekly schedule compliance is the primary measure of work execution and as a result a metric has been developed to measure schedule compliance.
28	Develop Daily Schedule	Normally it is the responsibility of the Supervisor to build Daily Schedules from the Weekly Schedule but in some instances, where practical, the Planner and Frontline Supervisor will develop daily schedules together. The Frontline Supervisor has: • The authority to schedule work as required on a daily basis except in the case where work dates are fixed (i.e. outages, arrangements with other departments, etc.) • Select employees to do the work • Deal with emergency and urgent work that affect their daily schedules, i.e. determine what low priority work will be removed from the schedule to deal with schedule breakers. • Move work orders to Status 46 (Daily Schedule).

Scheduling		
No.	**Name**	**Description**
29	Obtain Goods & Services for Priority 2 – Urgent Work	Priority 2 works is considered urgent in nature and must start within seven (7) calendar days as per Routine Work Prioritization Guide. • The Planning Supervisor will initiate fast track planning (outages, parts, etc.); establish target start date in consultation with Asset/Business Unit Manager and ECC/Operations. • If Goods and Services are required, the Planning Supervisor or designate will consult with Materials Management to determine a course of action. Communication is important here as this is outside the boundaries of planned procurement.
30	Outage Required (Priority 2 – (Urgent Work)	If an outage is required, the Planning Supervisor or designate will make the necessary arrangements through ECC/Operations.
31	Co-ordinate with ECC/ Operations/Customer (Priority 2 – Urgent Work)	Although work is of an urgent nature, Planning Supervisor or designate must communicate, co-ordinate with ECC, Operations and Customers. ECC needs to be involved with respect to: • Determine realistic outage date • Customer co-ordination • Energy supplier co-ordination (NUGS) • Operating Cost (fuel for auxiliary) • System security.

Execute the Work		
No.	**Name**	**Description**
32	Communicate Weekly Schedule	Communicating the weekly schedule to the employees is the responsibility of the Frontline Supervisor. The supervisor will move the work orders to In Progress (Status 48) as required.

Newfoundland & Labrador Hydro
Group of Companies

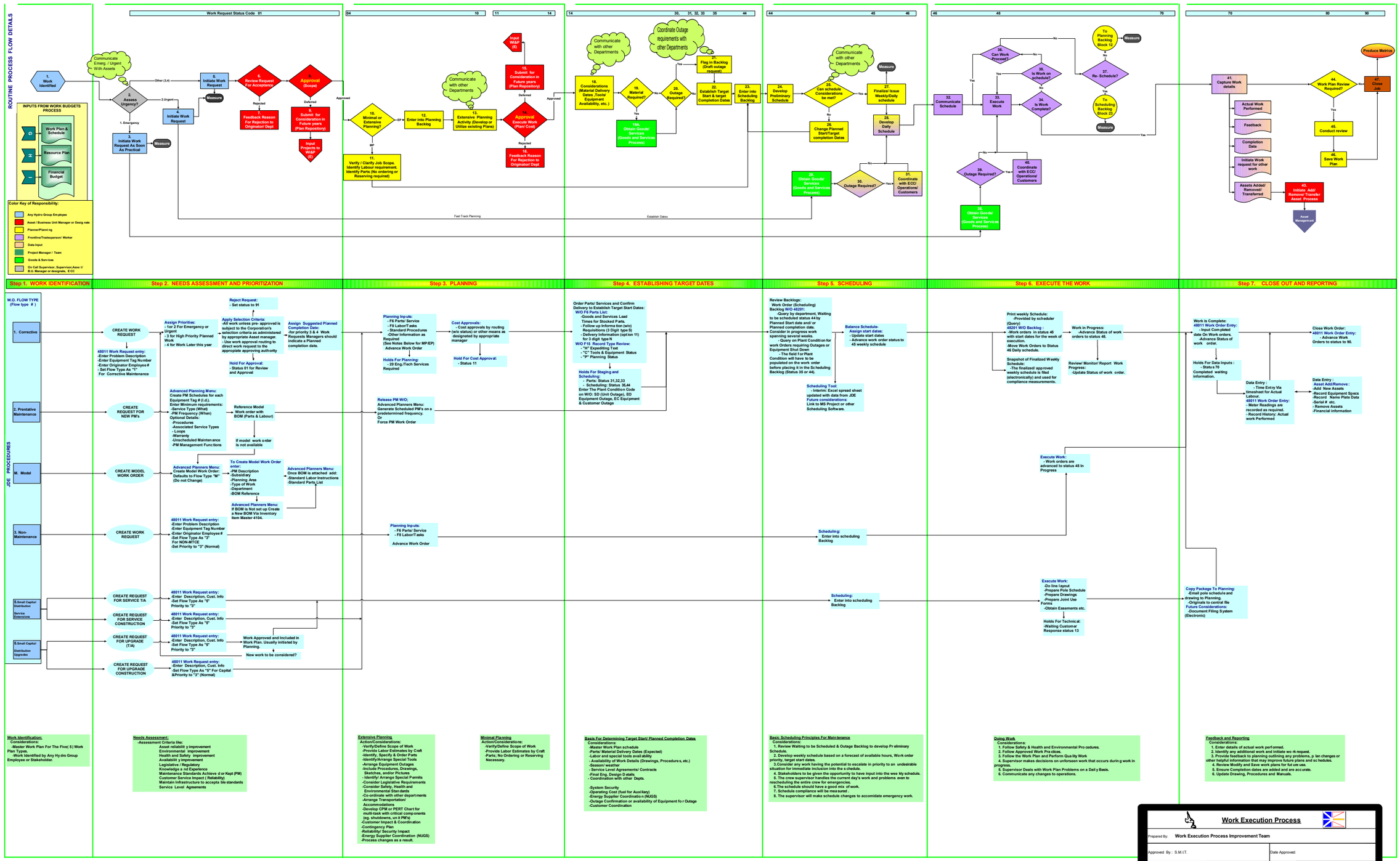
Execute the Work		
No.	**Name**	**Description**
33	Execute Work	This activity is the responsibility of the Trades People and the Supervisors. • Trades people and supervisors will decide how the work will be done using their knowledge, ability and expertise, unless specific job procedures are provided. • Trades people will use any information provided by the Planner that will assist in the execution of the work. (Job Procedures, Work Methods, etc) • Supervisors will monitor all aspects of work. • Supervisors will make on site decisions for work in progress. • Supervisors will decide how to handle extra work identified during the work in progress.
34	Is Work Complete	Work is considered to be complete when all work identified on the work order has been completed as requested and meets quality standards. Work on Weekly Schedule will be evaluated by the Labour Manager/ Business Unit Manager (TRO) and Department Frontline Supervisor during the week to discuss progress. • If work is complete, capture accurate work details. • If work is not complete, monitor schedule. • If there are work orders that didn't get acted on, Labour Manager, Planning Supervisor and Asset Manger will decide if the work will go on next weeks schedule or be returned for re-scheduling or re-planning.
35	Is Work On Schedule	Planned work orders are equipped with start and completion dates and estimated labour and material requirements. During execution of work, it is standard practice to monitor the schedule. • If work is on schedule but not complete, continue with execution of work.

Execute the Work		
No.	**Name**	**Description**
36	Can Work Proceed	While work is in progress, the supervisor will monitor schedule, budget and quality of work. If for some reason the work can't proceed, the supervisor will consult with Planning Supervisor who in coordination with Asset and Labor Manager, will decide if the work order will be returned for re-planning or re-scheduling.
37	Re-Schedule	If work can't proceed for any number of reasons (break in jobs, incorrect parts, etc.), the work order will either be returned for rescheduling or re-planning. Work orders in progress that must be returned for re-scheduling or re-planning will be measured (as indicated on the Process Flow Chart). Large numbers of in progress work orders being returned for re-scheduling or re-planning may be an indicator of problems in the execution process. Work orders on a weekly schedule that do not get acted on as planned and do not go to the next week's "weekly schedule" must either be returned for rescheduling or re-planning.
38	Obtain Goods & Services for Priority 1 – Emergency Work	Priority 1 (Emergency Work) must start immediately. Essentially the supervisor and the crew do planning for this type of work as the job progresses. Planner's time on emergency work should be limited but they will assist if required. If Goods and Services are required that involve Materials Management, the Frontline Supervisor or designate will consult with Materials Management personnel to determine appropriate course of action.
39	Outage Required Priority 1 – Emergency Work	If an outage has occurred or if an outage is required for emergency work, the Asset Manager or designate will consult with ECC/ Operations.
40	Co-ordinate Outage with ECC/Operations/Customer (Emergency Outage)	If an outage has occurred or if an outage is required under emergency circumstances, Asset Manager or designate will consult with ECC/operations to determine appropriate course of action.

Closeout & Reporting		
No.	**Name**	**Description**
41	Capture Work Details	The supervisor and crew are responsible for gathering all applicable information on the completed work order. Work details must include: • Condensed/concise details of actual work performed • Feedback on work order plan • Work order completion dates • Items found during the work that require initiation of another work required. Supervisor must move work order to Status 70 (Complete waiting information to be assigned to work order). Data input person enters information and moves W/O to status 80.
42	Assets Added/Removed/ Transferred	It is the responsibility of the Frontline Supervisor /Employee, during the close out and reporting stage, to determine if assets have been added, removed or transferred, and report same on completed work order.
43	Initiate Add/Remove/ Transfer Process	If assets have been added, removed or transferred, the data entry person shall activate the Asset Management Database and enter applicable information. The Asset Manager will approve the transaction.
44	Work Plan Review Required	All completed work orders are routed back to Planning. The Planning Supervisor or designate will determine if a work plan review is required. Significant, repeatable jobs will normally be reviewed.
45	Conduct Review	The responsible Planner will review the plan, including the feedback, and make all applicable changes.
46	Save Work Plan	The revised plan will be placed in a job plan repository for future use.
47	Close Job	Work order moves to Status 90 (Work Order History) within ninety days via automatic JD Edwards procedure.

Closeout & Reporting		
No.	**Name**	**Description**
48	Produce Metrics	The metrics in the Routine Work Plan Process are: • Weekly schedule compliance • Planned vs. unplanned hours of work • Emergency person hours worked • Work order compliance with estimates • Execution of compliance with various plan terms • Compliance to Work Plan Types • Re-scheduled/ Re-planned work orders • Preventive Maintenance Coverage • Wrench Time

Newfoundland and Labrador Hydro Group
Routine Work Flow



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Project Work Process Flow Chart

Process Flow Major Activities

Planning		
No.	**Name**	**Description**
1	Review/ Confirm/ Approved Work Plan	The individual who has been appointed Project Manager is responsible and initiates this activity. The Project Manager will review all components of the Approved Work Plan Package with the customer and make all necessary changes before proceeding with the work execution process. The Approved Work Plan will be made available to Work Execution after Cross Divisional Approvals have been completed. The components of the plan will include the following: • **Scope Statement** – The scope statement provides a documented basis for making future project decisions and for confirming or developing common understanding of project scope among the stakeholders. As the project progresses, the scope statement may need to be revised or refined to reflect approved changes to the scope of the project. • **Project Justification** – The business need that the project was undertaken to address. • **Objectives** – The quantifiable criteria that must be met for the project to be considered successful. Project Objectives must include at least cost, schedule and quality measures. • **Work Breakdown Structure (WBS)**- the work breakdown structure is the basis for determining required tasks or activities for all resources, vendors, services, or any other

Planning		
No.	**Name**	**Description**
		identifiable entity needed to complete the project. At its highest level, the work breakdown structure is the approach by which the objectives are to be met. The lowest level of the work breakdown structure defines specific tasks or activities to be performed and resources required. • **Deliverables** – a list of summary level sub products whose full and satisfactory delivery marks completion of project. For example, the major deliverables for a software development project might include the working application, a user manual and a tutorial. • **Assumptions** - Factors that, for planning purposes, are considered to be true, real or certain. Assumptions affect all aspects of project planning, and are part of the progressive elaboration of the project. Project teams frequently identify, document and validate assumptions as part of their planning process. For example, if the date that a key person will become available is uncertain, the team may assume a specific start date. Assumptions generally involve a degree of risk. • **Constraints** - A constraint is an applicable restriction that will affect the performance of the project. For example, a predefined budget is a constraint that is highly likely to limit the team's options regarding scope, staffing and schedule. When a project is performed under contract, contractual provisions will generally be constraints.

Planning		
No.	**Name**	**Description**
		• **Project Schedule -**The Project Schedule must include major project activities and milestones, activity duration estimates, activity sequencing and tentative start and finish dates. • **Resource Plan** -The resource plan must include the physical resources (people, special tools, equipment, materials), quantities of each required and date required to perform project activities. • The resource plan must be closely aligned with project major activities identified in the work breakdown structure and schedule. • The people requirement in the resource plan must be identified by craft and quantity of each craft to conduct the activity. • The resource plan must also indicate the project activities that will be completed by contractors. • The procurement for Goods and Services must include long lead items, goods and services resulting in extra ordinary demands on inventory and specialty items. • **Outage Plan** - The outage plan must include: • Equipment/assets affected by the outage. • Duration of outage. • Tentative start and finish dates, determined by consulting with Area Planning Departments and Energy Control Center

Planning		
No.	**Name**	**Description**
		/Operations/Hydro Quebec. • Participants in outage i.e. (IS&T, TRO etc) • Other work that may impact the outage. **Budget Plan –** The project budget plan must be: • A reflection of the activities in the work breakdown structure. • Must be broken out into budget amounts by cost category. • Must include cash flow based on project work plan.
2	Site Visit Required	The Project Manager in consultation with customer representative(s) will decide if a site visit is required to complete the review and confirm the approved Work Plan Package. • If a site visit is required, the Project Manager will arrange a meeting with the customer representative(s). • If a site meeting is not warranted, the Project Manager will make alternate arrangements with the Customer to review and confirm all components of the plan. Alternate methods might include e-mail, phone conference, etc.
3	Meet with Customer Representative(s)	The Project Manager will meet with customer representative(s) to review/confirm the approved Work Plan Package. • The customer/owner will determine how many customer representatives will attend the meeting.

Planning		
No.	**Name**	**Description**
4	Is the plan OK	When the project review is complete, the Project Manager and Customer Representative(s) will decide whether to proceed with the project as per the approved work plan package. The decision is based on results of the review. • If the Project Work Plan Package is acceptable with no or minor changes, the Project Manager and Customer Representative will sign off on the plan. • If the Project Work Plan Package is not acceptable, and major changes are required, request change and seek re-approval.
5	Seek Re-approval Request Change	If project changes are significant such as major scope or budget change, the Project Manger will request the changes and return project to WI&P for re-evaluation and re-approval.
6	Sign Off on Approved Plan	When Project Manager and Customer agree that plan is acceptable, they will sign off on plan.
7	Project Setup	When the Asset/Business Unit Manager has signed off on the Project, the Project Manager will proceed with the Project Set-Up. • The Project Manager is responsible to confirm that the budget has been set with the proper account code structure and estimates based on the project major activity list. When the WI&P and Work Budgets Process are implemented, the budget including the account code structure will be uploaded automatically as part of Work Budgets Process. Until these two processes are implemented, the Project Manager in consultation with the Asset/Business Unit Manager will ensure the budget is uploaded manually. • After the budget is uploaded to JDE, the Project Manager, the Asset/Business Unit Manager and

Planning		
No.	**Name**	**Description**
		area Planning Supervisor will consult with each other to determine the appropriate work orders to be put into JDE. The work orders will normally be aligned with the project activity list and shall include labor by craft, material requirement and minor/major contract requirement. The bottom line is that there must be an adequate number of work orders to manage and control the execution of work. Setting up work orders in JDE for execution of Project Work is essential. It's the media through which the customer: • Identifies, initiates, and describes work. • Prioritizes and approves work • Identifies & manages resources • Identifies Goods and Services Requirements. • Tracks and manages cost • Captures work history • Links cost and work order history to assets • Plans and Schedules work • Builds resource plans • Build work plans • Gathers data to analyze equipment failures and unacceptable budget variances.
8	Stakeholder Meeting	This meeting is arranged by the Project Manager and where practical should include all stakeholders. The purpose of the meeting is to: • To discuss project scope, project schedule, resource plan, outage plan, budget plan and any other applicable information. • To confirm/establish team members. • To outline roles and responsibilities of team members. • To develop a communications plan, which involves determining the information and communication needs off the stakeholders: who

Planning		
No.	**Name**	**Description**
		needs what information, when will they need it, how will they get it, and who gives it to them. (Refer to Appendix "C" for template of Communication Plan. • Assign responsibility for long lead items if not already assigned.
9	Act on Long Lead Items	Order long lead items sufficiently in advance to meet project start date.
10	Use Goods and Services Process	Request/Order Goods and Services sufficiently in advance to allow Materials Management adequate time to procure in time for planned start date.
11	Complete Detailed Engineering Design	Completing detailed Engineering Design involves: • Completing technical design work • Preparing equipment purchase/install contracts. • Preparing engineering drawings. • Preparing bill of materials. • Determining/arranging manufacturer requirements. • Developing pre-commissioning and commissioning checks. • Co-coordinating outage plan with Customer, ECC or Operations/Hydro Quebec. • Fine-tuning project schedule and project resource plan.
12	Review Final Design Package with Customer/Owner	Project Manager reviews final design details with customer/owner to ensure the design meets expectations and is within the project scope, schedule and budget.

Planning		
No.	**Name**	**Description**
13	Is Final Design OK	The Project Manager is responsible to obtain customer approval of the final design. • If the design is ok and no changes are required, the Project Manager will move forward with finalizing project plan details. • If minor changes are required, the Project Manager will be responsible for making those changes prior to finalizing project plan details. • If the final design is not ok and major changes are required i.e. scope, budget etc, then the Project Manager will document the change and resubmit to WI&P for re-evaluation and re-approval as indicated in the process flow chart.
14	Review/Modify Design	This step of the process is intended for minor revisions/modifications only and can be addressed between the Project Manager and the Customer. Even when minor changes are made, the Project Manager must revisit to see if other long lead items have been identified as a result of design change.
15	Finalize project plan details	Finalizing Project Plan Details normally includes the following: • Identify the asset(s) and add to asset master using Lotus Notes Asset Management Database. Add mandatory and other known information. Any additional information shall be added at project closeout. • Refer to procedures in Asset Record Management Process. • Confirm goods and service delivery dates. Major Contract Management may be required. • Arrange/confirm outage dates. • Arrange/confirm special tools. • Identify/arrange special permits, i.e. environmental, navigable waters, etc. • Identify/arrange orientation meetings. • Check availability of all resources (internal and external labor, tools & equipment, materials, etc.)

Establishing Target Dates		
No.	**Name**	**Description**
16	Establish/Confirm Target Start/Completion Dates	During the planning process, tentative start finish dates would most likely have been established. Now that all project plan details have been completed, the Project Manager is responsible to confirm existing dates or establish new ones. Communication with local planning departments is very important at this time. At this stage all long lead items would have been ordered and possibly other specialty items. All additional material can now be ordered to meet target start dates. When the job is ready to be scheduled, it's moved to "waiting to be scheduled backlog" (Status 44).

Scheduling		
No.	**Name**	**Description**
17	Can Schedule considerations be met	Scheduling of planned work of all types including capital and operating is done on a weekly basis. Planners extract work orders from the planned backlog based on priority, target start date, master schedule etc. As with all work, a final check is made to ensure all considerations can be met before committing to the weekly schedule. i.e. outage, manpower availability, material availability etc. If all considerations can be met, the work is moved to the weekly schedule.
18	Can Planned Target Start/ Completion Dates be changed?	If for some reason the project cannot be scheduled as per the plan, the Project Manager must: • Re-evaluate and adjust target start/completion dates. • Communicate with Project Manager/Team on changes to planned target start/ completion date. • Return to "waiting to be scheduled backlog". • If for some reason the project cannot be rescheduled for that year it must be redirected to the WIP process for re-evaluation.

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Scheduling		
No.	**Name**	**Description**
19	Develop/Follow Weekly Schedule	A Weekly Schedule Generator is used to load a schedule to capacity. Asset and labour managers to sign-off on schedule. • Schedule is normally loaded for a planning center and department • Schedule will normally include new planned work; carry over work and standing work. • Schedule will normally include a good mix of project work, routine work and high and low priority work. • When the schedule is loaded to capacity, a snapshot is taken before it is forwarded to the Frontline Supervisor for execution. Compliance to schedule is measured each week.

Execute the Work		
No.	**Name**	**Description**
20	Execute Project Plan	It's the responsibility of the Frontline Supervisor and Crew to execute the plan. The supervisor is responsible to address all issues associated with the weekly schedule.
21	Communicate Progress	The communication plan determines what information is required, who needs it, who is responsible to communicate it, the frequency at which it is required and the medium through which it is received.
22	Progress Reports	Progress Reports are submitted as per the communication plan.
23	Is Progress Acceptable	The project manager and frontline supervisor(s) determines if progress is acceptable by monitoring schedules, budget and the quality of work. If project progress is acceptable, continue to execute the plan. If unacceptable, the question must be asked, can project proceed.

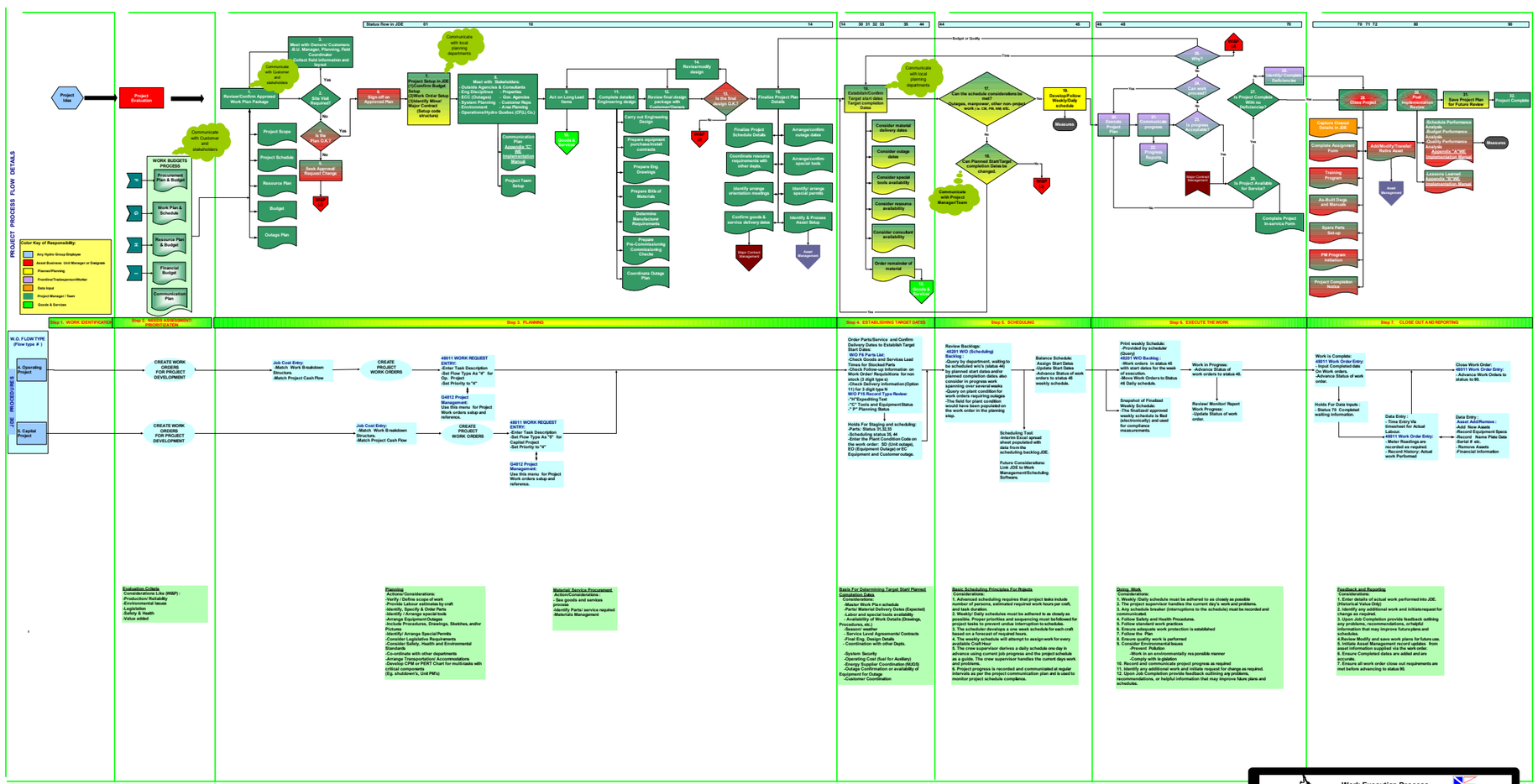
Execute the Work		
No.	**Name**	**Description**
24	Can Work Proceed	Although progress may not be acceptable, the Project Manager and Frontline Supervisor will determine if project can proceed. If yes, crew will continue to execute plan. If project cannot proceed, Project Manager must address the question “Why”
25	Why can’t project proceed?	The Project Manager must determine why work can’t proceed. There may be several reasons but the most common reasons are: • Major changes to project scope. When major scope changes are required, project must return to WI&P Process for re-evaluation. • Major budget overruns or projection of major budget overruns. Budget overruns or projection of overruns may be the result of inadequate budget estimates or unforeseen circumstances. This will again involve re-evaluating the project. • Time related problems. There may be cases where unforeseen circumstances will prevent the project from proceeding. Example (Outage cancelled or shortened.)
26	Is project available for service	• The project manager must determine when the project is available for service. To be available for service, all major work must be complete including function testing and commissioning. Project manager is responsible to ensure that prior to releasing System Equipment for Service, all conditions in Operations Standard Instruction #053 (Release for Service of System Equipment) have been met. There should be no issues affecting its in service capabilities but there may be minor deficiencies or minor work that does not affect its in service capacity. If it’s not available for service, then proceed with execution of plan. If it is available for service,

Execute the Work		
No.	**Name**	**Description**
		proceed to next step of process. Complete Project In-Service and Interest Cut-Off Notice (Form 60-537 R00-02. This is authorization to discontinue project interest (IDC) as of that date. • Project Manager should ensure adequate funds are available to address any deficiencies that could be outstanding on the project.
27	Is project complete with no deficiencies	If there are no deficiencies, proceed to project closeout. If there are deficiencies, properly address before closing project.
28	Identify/complete deficiencies	If there are deficiencies, the Project Manager must ensure they properly addressed before closing out the project.

Closeout and Reporting		
No.	**Name**	**Description**
29	Close Project	There are many activities that must happen as part of Project Closeout. • The JDE work order details such as actual work performed and actual completion dates must be added to work order and input to JD Edwards. The details are the responsibility of the Supervisor(status 70) and the input is the responsibility of the input clerk.(status 80) • Add, modify, transfer, retire asset(s) using the Lotus Notes Asset Record Management System. • Complete Asset Assignment Form. This is a new Asset Record Management Form, which is required by Finance to allocate funds to the applicable assets for the purpose of depreciation. Completion of this form is the responsibility of the Project Manager in consultation with the Asset/Business Unit

Closeout and Reporting		
No.	**Name**	**Description**
		Manager. Refer to appendix (E) for blank template. • As built drawings and manuals must be provided before Project Completion Notice is submitted. • Spare parts must be identified and set up before Project Completion Notice is submitted. • Preventive Maintenance Program must be set up before project completion. This will be the responsibility of the Asset Manager. • Training Programs, which were identified as part of the project, must be completed before Project Completion. Training costs incurred by the project normally includes program development and execution costs. Employee training expenses normally comes from the operating budget.
30	Post Implementation Review	• Schedule performance analysis. • Budget Performance analysis. • Quality Performance Analysis. • Lessons learned.
31	Save Project Plan for Future Use	If there is valuable information in this project plan that may be used for future use, it should be saved. Any work order information will be saved in JDE. Additional information will have to be saved elsewhere.
32	Project Complete	All Work Order Records will be moved to status 80 (complete). W/O will go to Status 90 after three months by automatic JDE process.

Newfoundland and Labrador Hydro Group
Project Work Flow



Work Execution Process

Prepared By: Work Execution Process Improvement Team

Approved By: S.M.I.T. Date Approved:

Revision: 04 - R01 Date Revised: 2004 - 12 - 01 Chart No. WE - 02

People Powered Performance

Newfoundland & Labrador Hydro Group of Companies

ROLES & RESPONSIBILITIES

Long-Term Asset Planning Manager

Maintenance Supervisor Maintenance

Worker

Operations Manager

Operations Supervisor

Operations Worker

Planning Supervisor

Planner

Planning Clerk

Scheduling Supervisor

Work Execution Manager

Roles & Responsibilities

Long-Term Asset Planning Manager

Summary of Job Function

Leads LT asset planning and critical spares management activities. Accountable for developing and refreshing the 20+ year asset plan addressing asset rehabilitation / overhaul, renewal and replacement. Drives development of annual asset work plan and provides oversight and input into effectiveness of asset maintenance activities including preventative and predictive maintenance.

Principal Activities, Duties and Responsibilities

1. Develop and continually refresh 20+ year asset plan that reflects: asset rehabilitation/overhauls to major assets; asset renewal requirements – what needs to be replaced, when and with what.

2. Create/maintain accurate & complete asset listing/hierarchies with supporting detail, location, history, financial information.

3. Translate 20 year asset plant into detailed 5-year and annual asset work plans; update as required.

4. Recognizing the dynamic nature of long and short-term asset work plans and the expertise of others, obtain input from work execution and operations functions when developing/refreshing long-term, 5-year and annual asset work plans.

5. Participate in technical councils and use councils to test long-term plans, promote their role in operational trouble-shooting.

6. Develop high-level implementation strategy including financial leveling, resource planning for each year of the LT asset plan.

7. Drive development of the 20 year capital plan inputs for assets.

8. Check/ensure alignment with corporate long-term asset planning practices led by the office of asset management.

Roles & Responsibilities

Long-Term Asset Planning Manager continued…

9. Ensure project scope, estimates and quality are acceptable.

10. Identify and monitor asset reliability / service level requirements.

11. Complete root cause failure analysis and remedial action plans.

12. Complete risk assessment and reliability monitoring.

13. Develop, monitor and continuously improve preventative and predictive maintenance programs.

14. Develop and implement condition assessment tools and monitoring techniques, incorporate results into planning activities.

15. Monitor and incorporate industry and technology trends impacting long-term asset plan.

16. Use critical spares framework established by the Office of Asset management to identify critical equipment/tools spares based on criteria including: acceptable downtime/service levels; impact to reliability; delivery time; failure history; and repair duration.

17. Determine quantity, lead times, and optimum inventory levels.

18. Initiate the procurement of critical spares and ensures correct equipment is specified, ordered and received.

19. Develop necessary inspection/review/maintenance/location requirements on critical equipment/tools spares to ensure readiness including monitoring OEM supplier support and equipment/tools availability.

Roles & Responsibilities

Long-Term Asset Planning Manager continued…

20. Participates in post implementation reviews of project work.

21. Participates in the cancellation of PM's.

Roles & Responsibilities

Maintenance Supervisor

Summary of Job Function

Drives Work Execution Efforts through execution of weekly work schedules. Supports planning efforts by aiding planner in producing efficient work packages. Responsible to ensure workers under his/her direction perform activities in a safe and efficient manner. Participates in the weekly scheduling meetings.

Principal Activities, Duties and Responsibilities

1. Provide planning with craft hours available forecast for next Week's work schedule.
2. Communicates weekly/daily schedules to employees.
3. Assigns work orders to individual workers.
4. Ensure that Tailboard Safety Talks are completed during work assignments, or ensures persons are assigned lead to conduct.
5. Ensures all special permits are in effect.
6. Follows work plan packages produced by planning.
7. Resolves daily work plan package problems.
8. Adjusts daily work schedule to handle emergency work.
9. Monitors work in progress with respect to schedule, budget and quality.
10. Makes decisions on unforeseen events that occur during work in progress.
11. Ensures safety and health, environment and regulatory requirements are followed.
12. Co-ordinates returning of equipment to operations, returning surplus parts to inventory, and returning tools to tool crib.
13. Communicates to Operations any changes that were a result of work done.
14. Evaluates close out data on work orders and ensures all work orders are returned to planning including PM check sheets.
15. Generates work request for any additional work identified.

Roles & Responsibilities

Maintenance Supervisor continued…

16. Moves work orders through JDE status indicators from 45 to 71.

17. Returns last week's schedule to planning indicating jobs completed & Break in List

18. Explains variances in weekly schedule if required.

19. Responsible to ensure changes to equipment, system or process are approved by Long Term Asset Planning prior to making change.

Roles & Responsibilities

Maintenance Worker

Summary of Job Function

Part of the work Execution Team. Performs work on assets under the direction of the FLS (front line supervisor). Responsible for conducting work in a safe and efficient manner following all corporate policies and guidelines. Assist in the development and assessment of work methods.

Principal Activities, Duties and Responsibilities

1. Responsible to understand scope and technical details of work.
2. Ensures safety, health; environmental and regulatory requirements are understood and followed.
3. Follows approved work practices; including Work Methods, TBRA's, etc.
4. Follows work plan and where specific procedures are not provided, use knowledge, skill and expertise to perform the work in a safe, efficient and effective manner.
5. Responsible for administering Trades Administered Work Permits.
6. Works within schedule and labour estimates provided in the work plan package.
7. When working at plants, structures, or stations, ensure the proper authorities are aware of work being done.
8. Notifies proper authorities of any changes that affect production/operation as a result of work that was done.
9. Ensures equipment has been checked and tested before release for service.
10. Returns unused parts and tools to proper location.
11. Records asset tracking information as per information on work request.
12. Provides feedback on work plans package to planners.
13. Reports actual work performed on work orders.
14. Initiates work request for additional work activities.

Roles & Responsibilities

Operations Manager

Summary of Job Function

Leads the safe operation of assets in accordance with the basis of design and established operating parameters.

Principal Activities, Duties and Responsibilities

1. Focus on safe, environmentally friendly and efficient operation of the assets of utilization of the resource.
2. Monitor asset performance for proper operation to minimize potential for loss.
3. Monitor asset efficiency and performance, adjust operations as required.
4. Lead / provide input for outage management with particular attention to customer requirements.
5. Administer Work Protection Code for Production related operations.
6. Collect and maintain appropriate operating (condition) data for technical analysis and other uses.
7. Maintain effective relationships with customers.
8. Develop / maintain operating procedures, drawings and other documentation.
9. Recognizing the dynamic nature of long and short-term asset work plans and the expertise of others, provide input to long-term planning function (developing / refreshing long-term, 5-year and annual asset work plans).
10. Responsible for assigning/approving priority ranking to work orders using the Routine Work Management Process.
11. Provides input to weekly schedule development.
12. Reviews and approves unit/equipment outages.
13. Responds to emergency work situations and co-ordinates activity as required.
14. Responsible for initiation of training program on new assets.
15. Review Work Activity versus Work Plan as per frequency established in area.

Roles & Responsibilities

Operations Supervisor

Summary of Job Function

Directs activities of the Plant or Town operations group. Directs operation of assets to ensure they are operated in a safe environmentally manner. Responsible for application of WPC and outage schedule

Principal Activities, Duties and Responsibilities

1. Directs the activities of Operations Personnel.
2. Provides technical guidance to operating personnel.
3. Provides Work Protection Guidance to Operating Personnel.
4. Attends weekly co-ordination meetings to discuss and prepare for operating requirements for next week's work schedule.
5. Communicates work requirements to operating personnel in advance to eliminate delays during the execution of work.
6. Review work order backlog for work that affects or has potential to affect operations / production and use as input to weekly schedules.
7. Maintain a current knowledge on the latest maintenance technology applicable to the technical and operation area of responsibility.
8. Provides Long Term Asset Planning with accurate feedback on asset performance

Roles & Responsibilities

Operations Worker

Summary of Job Function

Part of the Asset Management Team. Responsible for operating assets in a safe and efficient manner within the assets operational parameters. Monitors condition of assets and reports abnormalities to Operations Supervisor.

Principal Activities, Duties and Responsibilities

1. In Production area, responsible for administering Operator Administered Permits.
2. In Production area, controlling Authority for work on equipment under their jurisdiction.
3. Participates in testing of equipment under their jurisdiction if required.
4. Responsible for operating inspections on equipment.
5. Responsible for initiating work requests for deficiencies found on equipment/ systems.
6. Participates in run up and / or testing of equipment that was worked on prior to release for service.
7. Participates in pre-start operational checks.
8. Performs identified running maintenance activities.
9. Trend monitors critical equipment and initiates work request in advance of trouble.
10. Ensures applicable operating / isolating procedures are followed.
11. Following approved operating / isolating procedures.

Roles & Responsibilities

Planning Supervisor

Summary of Job Function

Lead the planning of work to deliver the work outlined in the annual work plan by developing 7 and 30 day work schedules. Determines resource, materials, tools and equipment requirements to complete planned work and generates work orders and other documentation to support work execution.

Principal Activities, Duties and Responsibilities

1. Ensures planners are adequately trained.
2. Co-ordinates development and ensures timely implementation of plans and schedules for work.
3. Directs/guides day-to-day planning and scheduling activities.
4. Conducts weekly co-ordination meetings.
5. Co-ordinates development of weekly and/ or daily schedules.
6. Works with the Scheduling Supervisor to co-ordinate development of CPM schedules for project type work.
7. Determines extensive vs. minimal planning requirement for work orders.
8. Performs quality assurance checks on planned work orders.
9. Ensures valuable work plan packages are reviewed, upgraded and saved for future use.
10. Provides guidelines for planner's involvement in emergency work.
11. Liaison for co-coordinating work/outages with Operations Manager and Project Construction Co-ordinator.
12. Responsible for compiling information on metrics.
13. Accountable for the delivery of the Annual Work plan in conjunction Work Execution Managers
14. Coordinates weekly schedules are established with right mix of work.
15. Gates work into Annual Work Plan.

Roles & Responsibilities

Planning Supervisor continued…

16. Verify readiness for next week's work for materials, resources, timing, and input from supervisors (weekly scheduling meeting).

17. Works with planners to establish any new target dates.

18. Meet with Operations, LTAP, and WEMs to discuss scheduled work that cannot be completed in established dates.

Roles & Responsibilities

Planner

Summary of Job Function

Prepares job plans for the Execution Group. Refines scope of work orders, plans and prepares work for scheduling and execution. Note that planner refers to the person planning the work and may refer to ta Project Manager, a Supervisor, Electrical Planner, Mechanical Planner, etc.

Principal Activities, Duties and Responsibilities

1. Makes fields inspections and determines appropriate job work scopes.
   - Site visits to determine exact scope
   - Note any complications for the work
   - Refine scope as required
2. Develops detailed work plans for work orders
   - Plans for Materials Required
   - Determine Labor Requirements & Time Estimates
   - Special Equipment Requirements
   - Accommodation Requirements
   - Develops CPM for multitask/multicraft work larger work
   - Special Permit Requirements
   - Safety Related Requirements i.e. work methods/regulations
   - Have materials kitted & delivered when work is scheduled
3. Establishes realistic target start dates for work orders.
4. Reviews, upgrades and saves work packages for future use.
   Responsible for collection of Weekly Schedule & Break in List
5. Aid development of weekly schedules in conjunction with work coordination
6. Provides technical assistance for maintenance personnel as required.
7. Communicates regularly with department frontline supervisors, work coordination and other stakeholders on work order planning and scheduling issues.
8. Participates in weekly coordination meetings.
9. Ensures equipment outages have been arranged.

Roles & Responsibilities

Planning Clerk

Summary of Job Function

Supports planning and work execution efforts by performing clerical duties for planning. Maintains several databases as required. Enters and files documentation as a result of planning and work execution efforts.

Principal Activities, Duties and Responsibilities

1. Keying work orders for work requests

2. Maintain & Populates(if required) following Databases;
   - PCB Database
   - High Pressure Welding Database
   - Switchyard Leaks Database
   - Training Database
   - Vehicle History Database
   - Vacation Database
   - Regular Meeting Requests

3. Maintain written records supporting above Databases.

4. Form Maintenance.

5. Work order closeout & Work order Requests as indicated.

6. Assist in Accommodation/Transportation Arrangements as required.

7. Files completed PM check sheets.

Roles & Responsibilities

Scheduling Supervisor

Summary of Job Function

Accountable for the maintenance of the Annual Work Plan database and assists Planning Supervisor with co-ordination of all work within the Annual Work Plan.

Principal Activities, Duties and Responsibilities

1. Populates and maintains Primavera Database
2. Ensures all work is entered into Annual Work Plan
3. Tracks Activity Completion in Real Time
4. Tracks availability of Labor Resources in real time
5. Tracks availability of Non labor Resources in real time
6. Publishes Schedules as requested
7. Works with Planning Department to develop schedules and timelines
8. In conjunction with the Project Construction Co-ordinator, co-ordinate all work to ensure all resources requested are available
9. Alerts Planning Supervisor/Applicable Managers of any potential problems with the upcoming weekly and four week schedules
10. Tracks project execution and statistics

Roles & Responsibilities

Scheduling Supervisor continued…

11. Develops "What if" schedules to aid in evaluation of any changes to the Annual Work Plan.

12. Assists Project Co-ordinator with tracking of Project Activity Completion and alerts Project Manager of any potential problems with either projects or the Annual Work Plan Schedules.

13. Coordinates with PETs Planning Scheduler to ensure Capital work schedules are aligned with Annual Work Plan Activities.

Roles & Responsibilities

Work Execution Manager

Summary of Job Function

Leads the planning and execution of work plan in a safe, environmentally friendly and effective manner.

Principal Activities, Duties and Responsibilities

1. Focus on safe, environmentally friendly and effective (quality, cost, and schedule) execution of weekly, monthly and annual asset work plans.
2. Manage trades, tools and equipment resources required for work completion.
3. Integrate capital and operating project work including resource provisioning and associated commissioning coordination.
4. Prioritize work and monitor actual work completed against schedule; take action as necessary.
5. Supervise frontline supervisors.
6. Maintenance budget cost control.
7. Monitor maintenance execution productivity and effectiveness and monitor and report on work execution metrics.
8. Management and renewal of major contracts for equipment overhauls and minor service contracts.
9. Maintain effective record keeping (work order history and other work execution related documentation).
10. Recognizing the dynamic nature of long and short-term asset work plans and the expertise of others, provides input to long-term planning function (developing / refreshing long-term, 5-year and annual asset work plans).

Roles & Responsibilities

Work Execution Manager continued…

11. Responsible for assigning priority ranking to work orders using the Routine Work Management Process.

12. Performs regular reviews of work order backlog for delinquent PM work orders and other work orders with potential to escalate in priority.

13. Monitors size of planned work order backlog.

14. Provides input to weekly schedule development.

15. Review weekly work schedule compliance with supervisor.

16. Review work order estimates versus actual at work order level.

17. Participates in post implementation reviews of project work.

18. Provides technical guidance to labour force when required.

19. Responds to emergency work situations and co-ordinates work as required.

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METRICS

Metrics simply means the measures and scores of particular process activities or results. Metrics involve selecting, collecting, analyzing, and presenting data.
In order to improve we must become an intelligent force behind an all-inclusive and a persistent development plan for the work execution process. To be an intelligent force means to become informed through the use of measurements. By comparing how well we are doing to other divisions within and to other companies we can establish meaningful targets for improvement. Communication of these targets is achieved through inclusion in annual divisional goals and objectives.

Indirect Measures

Doing the right thing somewhat ineffectively is more important than doing the wrong things very well. For example, how do measurements for the percentage of emergency hours worked and percentage of unplanned vs. planned hours worked apply to the success of work execution? The answer lies in this statement “If you are always putting out fires you will never reap the benefits of planning and scheduling”. Planning and scheduling are two key steps in the work execution process. The benefits of advanced planning and scheduling is in the reduction or even the elimination of delays. If we are always putting out fires then we are too reactive and steps need to be taken towards breaking that cycle and becoming more proactive. After we become confident that we are doing the right things we can put more effort into doing them well.

After the work execution process is implemented the 9 metrics identified in this section will help establish a baseline for improvement. The analysis of individual and combinations of these measures will highlight improvement needs.

Metrics associated with the Work Execution Process are:

- Weekly Schedule Compliance
- Compliance to Annual Work Plans
- Work Order Compliance with Estimates
- Emergency Person Hours Worked
- Planned vs. Unplanned Person Hours Worked
- Preventive Maintenance Coverage
- Percentage Re-planned Work Orders
- Percentage Rescheduled Work Orders
- Wrench Time

Metric Title: **% Weekly Schedule Compliance**

Metric Background:
The primary purpose of the weekly schedule compliance metric is to provide a means of measuring weekly schedule compliance. This measure will be manually calculated to begin but electronically calculated in the future. The success of the Work Execution Process depends upon our ability to produce realistic, achievable weekly schedules that attempts to assign work for every available craft hour. Building these realistic weekly schedules is important but measuring compliance to these schedules is equally important.

Metric Definition:
The compliance to each work order will be measured individually and then averaged to give weekly compliance. The guidelines for measuring compliance are:

a. Work Order Completed during week 100%
b. Work Order not acted on 0%
c. Hours worked > hours scheduled 100%
d. Hours worked < hours scheduled (40 worked, 50 scheduled) 80%

Example Table: **4.0 Sample of Schedule Compliance Measure**

Total Available Hours = 200					
	Job #	**Hours Scheduled**	**Job Complete**	**Hours Worked**	**% Compliant**
	1	20	Yes	20	100%
	2	30	No	50	100%
	3	5	Yes	10	100%
	4	10	Yes	10	100%
	5	25	No	20	80%
	6	20	Yes	30	100%
	7	40	No	40	100%
	8	20	No	15	75%
	9	10	No	5	50%
	10	20	No	0	0%
Total	**10**	**200**		**200**	**805%**
Total Line #5 Divided by Total Line #1 805/10 = 80.5% Compliance with Schedule					

Supporting Information:
The schedule compliance will be measured and documented each week. Until we go with the electronic measurements, the area will have to make arrangements locally for storing and graphing the compliance data.

Frequency of Generation:
The weekly schedule compliance will be measured and documented on a weekly basis.

Generated by:
The Labor/ Business Unit Manager or designate will be responsible for documenting and compiling the data.

Target:
Industry Average is 80% or higher. Departments/Divisions will establish compliance targets as part of their annual goals and objectives.

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Metric Title: **% Work Order Compliance with Estimates**

Metric Background:
Two key components of work execution is effective planning (realistic labor and material estimates) and effective/efficient execution of the job (completing quality work on time and on budget). To see how well we comply with work order estimates, we have developed a metric, " Work Order Compliance with Estimates". The metric tells us what percentage of all work orders completed within a specified time frame was completed within an acceptable variance (+/_ 15%) of total estimated cost (labor, material, other cost). The variance field needs to be changeable as management may decide to change what is acceptable as the execution process improves.

Metric Definition:
% Work Order Compliance with Estimates =

$$\frac{\text{\# planned wo's completed within variance (±15\%) of total est cost}}{\text{Total \# planned work orders completed within specified time frame.}} \times 100$$

Supporting Information:
Specified time frame is the date range for which work orders were completed. Example January 1, 2005 thru March 31, 2005.

Work Orders completed are all work orders in the specified time frame that are at status 70 thru 95.

Planned work orders are all priority 3 and 4 work orders. They may include corrective, preventive, non-maintenance, operating and capital projects.

Total estimated cost includes labor cost, material cost and other cost.

Specified variance of +/- 15% of total estimated cost is what industry considers acceptable.

Total estimated cost includes estimated labor, material and other cost.

Prompts must include Planning Center, Business Unit, Dept/Section, Planner and start and end dates.

Example: Suppose 200 planned work orders (priority #3 & #4 of a corrective, preventive, non maintenance, operating or capital nature were completed (moved to status 70,80 or 90) in a specified time range (say January 1,2005 thru March 31, 2005 and say 75 of these work orders were completed within +/- 15% of total estimated cost:

$$\% \text{ Compliance to Work Order Estimates} = \frac{75}{200} \times 100 = 37.5\ \%$$

This means that of the 200 work orders completed during that time frame, 37.5% were completed within the acceptable variance of +/- 15% as compared to the target of 65%

Frequency of Generation:
This metric will be generated and documented on a quarterly basis. The first quarter report would be generated in mid April to capture timesheet entry data from end of March.

Generation #1Period	January 1st thru March 31st
Generation #2 Period	January 1st thru June 30th
Generation #3 Period	January 1st thru October 31st
Generation #4 Period	January 1st thru December 31st

Note: Generate the metric two (2) weeks after generation period end date to ensure the latest time sheet entry data.

Generated by:
The Planning Superintendent, Planning Supervisor or designate.

Target:
Industry average for work order compliance within +/15% of total estimated cost is 65%. The divisions within Hydro will establish their own targets.

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Work Order Estimate to Actual Variance (Summary Report Documentation)

Introduction

The Work Order Estimate to Actual Variance report was developed to provide a means by which a Panning Center may identify work order having suspect estimated and/or actual cost. The report utilizes the Showcase Strategy report writer. The BPI Work Execution team provided the criterion used to develop this report.

This report does not represent a comprehensive variance analysis process, but rather a tool used by the process.

Data Source

Report returns column data from the following JD Edwards WorldSoftware production tables:

- **F4801 Work Order Master**
  - WO Number
  - Description
  - Planning Center
  - Completion Date
  - Planner
  - Department
  - Type
  - Priority
  - Estimated Total Cost

- **F3111Work Order Parts List**
  - Estimated Materials Cost

- **F3112 Work Order Routing Instructions**
  - Estimated Labour Hours
  - Estimated Labour Cost (Hours * Rate calculation)

- **F0911 General Ledger**
  - Actual Labour Hours (Doc Type = T4)
  - Actual Labour Cost (Doc Type = T4)
  - Actual Materials Cost (Doc Type = II)
  - Actual Other Cost (Doc Type <> T2, T4, or II)
  - Actual Total Cost (Doc Type <> T2)

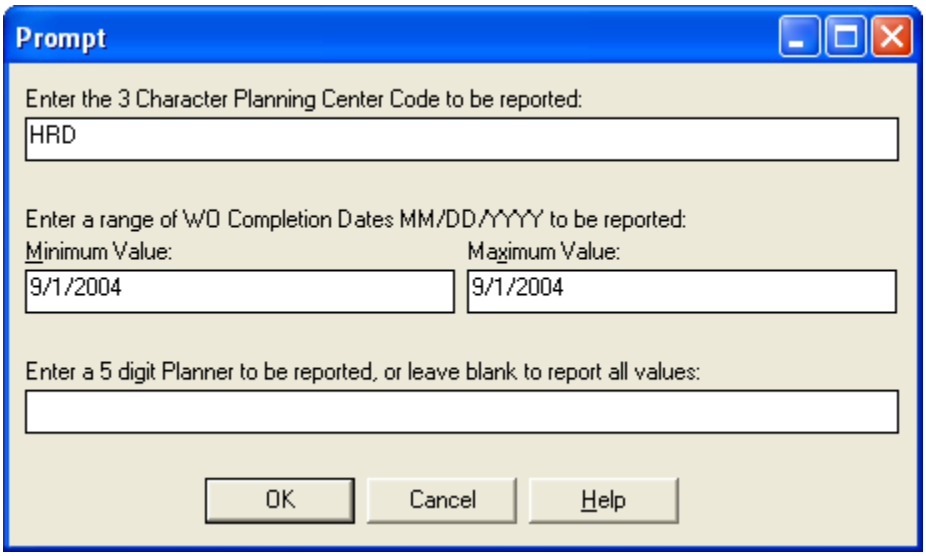
- **Calculated Report Column**
  - Variance (Actual Total Cost – Estimated Total Cost)

Data Sort & Totaling

- The report returns records for a Planning Center sorted in ascending order by Planner, Department.
  - Note: The SQL statement used by this report differs from that used by standard Showcase Strategy reports. This is due to the nature of the incoming report data, specifically the (many to many) relationship between tables. Therefore, the ability to perform extensive sorting may be limited.
- Data is grouped and totaled by (1) Work Order (2) Planner and (3) the entire report.
  - Note: Although the report appears to return a detail record by Work Order, it is in fact returning a summary record. This is based on the nature of the incoming report data.

Report Execution

Upon execution the report will prompt the user to supply values to three conditions. The first two conditions are mandatory, whereas the third is optional.



- The first prompt requests a 3-character value representing the Planning Center for which the report is to be executed. This value corresponds with the value contained by the Work Order's Category Code # 10.

- **Prompt for Business Unit**

- **Prompt for Department / Section**

- The second prompt requests a range of Work Order Completion Dates for which the report is to be executed. The form of the values must be MM/DD/YYYY.

- The third prompt requests a 5 digit value representing the Planner identification number. This value corresponds with the Planner field found on the Work Order master record.

Testing of the report for Planning Center HRD with a Completion Date range of 09/22/2004 – 09/23/2004 indicate execution times generally less than 3 minutes. Execution time may vary depending on system resource availability.

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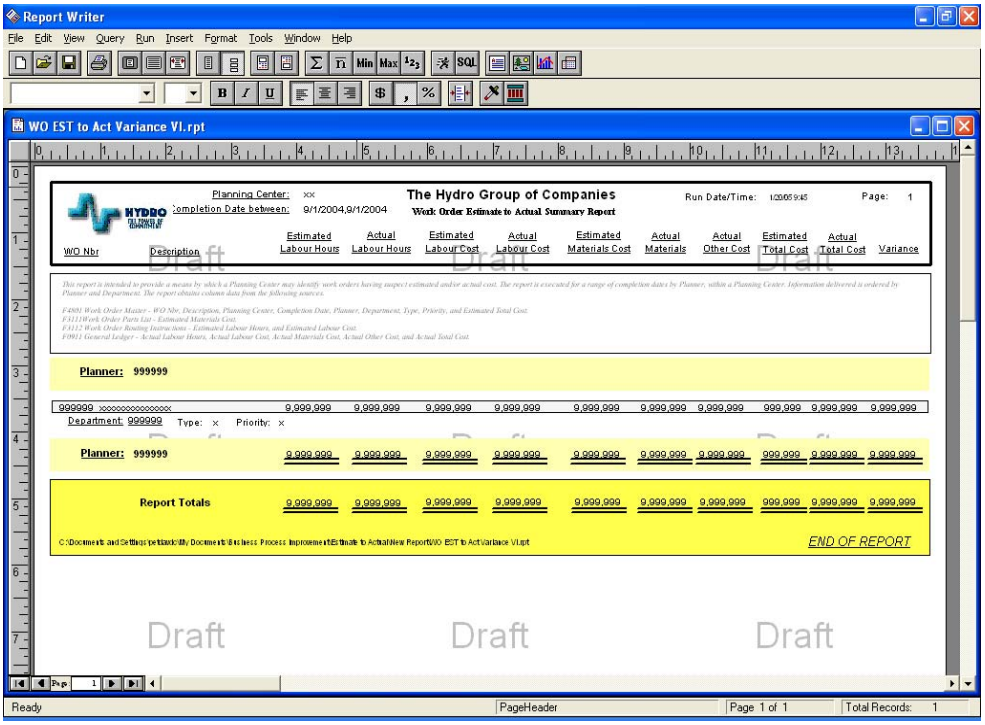
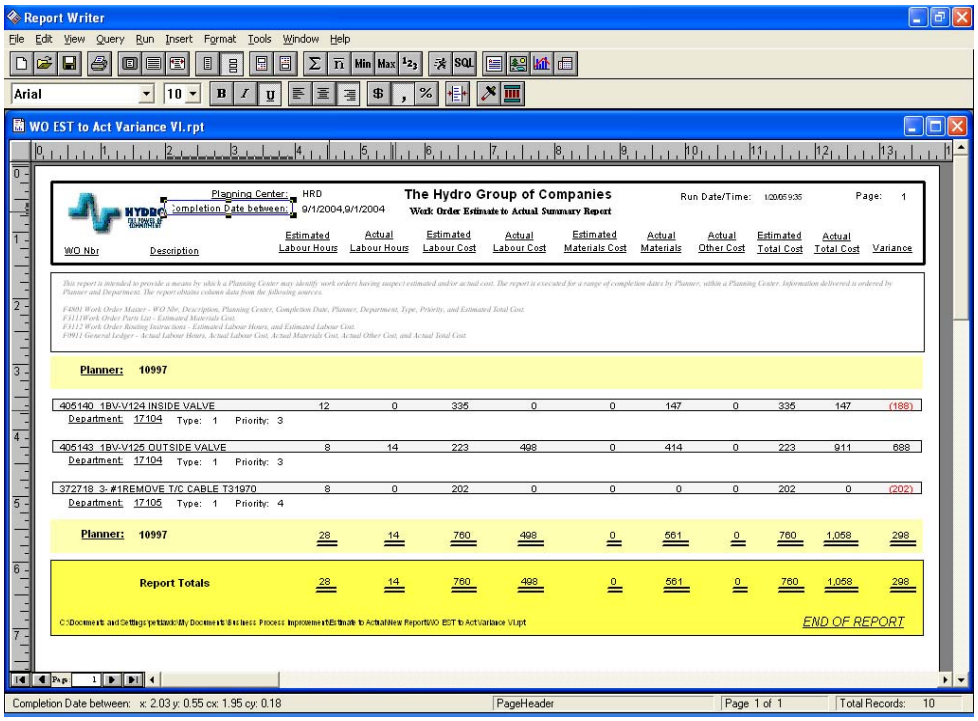
Sample Report Screen Shots





Report Query Select Statement

```
SELECT
WAWR10 AS COLUMN0001,
WAANSA AS COLUMN0002,
WAANPA AS COLUMN0003,
Date( WASTRX, CYYDDD ) AS COLUMN0004,
WADOCO AS COLUMN0005,
WADL01 AS COLUMN0006,
WATYPS AS COLUMN0007,
WAPRTS AS COLUMN0008,
0 AS COLUMN0009,
0 AS COLUMN0010,
0 AS COLUMN0011,
0 AS COLUMN0012,
0 AS COLUMN0013,
0 AS COLUMN0014,
0 AS COLUMN0015,
WAAMTO AS COLUMN0016,
0 AS COLUMN0017,
0 - WAAMTO AS COLUMN0018
FROM
PRDDTA.F4801 F4801
WHERE
WAWR10 = &PlanCenter
AND Date( WASTRX, CYYDDD ) BETWEEN &CompDate AND &CompDate
AND WAANSA = &Planner

GROUP BY
WAWR10,
WAANSA,
WAANPA,
WASTRX,
WADOCO,
WADL01,
WATYPS,
WAPRTS,
WAAMTO,
0 - WAAMTO
```

```
UNION SELECT
WAWR10 AS COLUMN0001,
WAANSA AS COLUMN0002,
WAANPA AS COLUMN0003,
Date( WASTRX, CYYDDD ) AS COLUMN0004,
WADOCO AS COLUMN0005,
WADL01 AS COLUMN0006,
WATYPS AS COLUMN0007,
WAPRTS AS COLUMN0008,
0 AS COLUMN0009,
0 AS COLUMN0010,
0 AS COLUMN0011,
0 AS COLUMN0012,
SUM( WMUORG * WMEA ) AS COLUMN0013,
0 AS COLUMN0014,
0 AS COLUMN0015,
0 AS COLUMN0016,
0 AS COLUMN0017,
0 AS COLUMN0018

FROM
PRDDTA.F4801 F4801,
PRDDTA.F3111LA F3111LA
WHERE
F4801.WADOCO = F3111LA.WMDOCO
AND ( ( WAWR10 = &PlanCenter)
AND Date( WASTRX, CYYDDD ) BETWEEN &CompDate AND &CompDate)
AND WAANSA = &Planner

GROUP BY
WAWR10,
WAANSA,
WAANPA,
WASTRX,
WADOCO,
WADL01,
WATYPS,
WAPRTS
```

```
UNION SELECT
WAWR10 AS COLUMN0001,
WAANSA AS COLUMN0002,
WAANPA AS COLUMN0003,
Date( WASTRX, CYYDDD ) AS COLUMN0004,
WADOCO AS COLUMN0005,
WADL01 AS COLUMN0006,
WATYPS AS COLUMN0007,
WAPRTS AS COLUMN0008,
SUM( WLRUNL ) AS COLUMN0009,
0 AS COLUMN0010,
SUM( WLRUNL * WLPWRT ) AS COLUMN0011,
0 AS COLUMN0012,
0 AS COLUMN0013,
0 AS COLUMN0014,
0 AS COLUMN0015,
0 AS COLUMN0016,
0 AS COLUMN0017,
0 AS COLUMN0018

FROM
PRDDTA.F4801 F4801,
PRDDTA.F3112LA F3112LA
WHERE
F4801.WADOCO = F3112LA.WLDOCO
AND ( ( WAWR10 = &PlanCenter)
AND Date( WASTRX, CYYDDD ) BETWEEN &CompDate AND &CompDate)
AND WAANSA = &Planner

GROUP BY
WAWR10,
WAANSA,
WAANPA,
WASTRX,
WADOCO,
WADL01,
WATYPS,
WAPRTS
```

```
UNION SELECT
WAWR10 AS COLUMN0001,
WAANSA AS COLUMN0002,
WAANPA AS COLUMN0003,
Date( WASTRX, CYYDDD ) AS COLUMN0004,
WADOCO AS COLUMN0005,
WADL01 AS COLUMN0006,
WATYPS AS COLUMN0007,
WAPRTS AS COLUMN0008,
0 AS COLUMN0009,
SUM ( CASE
WHEN GLDCT = 'T4' THEN GLU
END ) AS COLUMN0010,
0 AS COLUMN0011,
SUM ( CASE
WHEN GLDCT = 'T4' THEN GLAA
END ) AS COLUMN0012,
0 AS COLUMN0013,
SUM ( CASE
WHEN GLDCT = 'II' THEN GLAA
END ) AS COLUMN0014,
SUM ( CASE
WHEN GLDCT <> 'T2' AND GLDCT <> 'T4' AND GLDCT <> 'II' THEN GLAA
END ) AS COLUMN0015,
0 AS COLUMN0016,
SUM ( CASE
WHEN GLDCT <> 'T2' THEN GLAA
END ) AS COLUMN0017,
SUM ( CASE
WHEN GLDCT <> 'T2' THEN GLAA
END ) - 0 AS COLUMN0018

FROM
PRDDTA.F4801 F4801,
PRDDTA.F0911LK F0911LK
WHERE
DIGITS( F4801.WADOCO ) = F0911LK.GLSBL
AND ( GLSBLT = 'W'
AND WAWR10 = &PlanCenter
AND Date( WASTRX, CYYDDD ) BETWEEN &CompDate AND &CompDate)
```

AND WAANSA = &Planner

GROUP BY
WAWR10,
WAANSA,
WAANPA,
WASTRX,
WADOCO,
WADL01,
WATYPS,
WAPRTS

Work Order Estimate to Actual Variance (Detail Report Documentation)

Introduction

The Work Order Estimate to Actual Variance Detail report was developed as a means to analyze specific work orders having suspect estimated and/or actual cost. The report utilizes the Showcase Strategy report writer. The BPI Work Execution team provided the criterion used to develop this report.

This report does not represent a comprehensive variance analysis process, but rather a tool used by the process.

Data Source

The report returns column data from the following JD Edwards WorldSoftware production tables:

- **F4801 Work Order Master**
  - WO Number
  - Description
  - Planning Center
  - Completion Date
  - Planner
  - Department
  - Type
  - Priority
  - Estimated Total Cost

- **F3111Work Order Parts List**
  - Estimated Materials Cost
  - Estimated Materials Description

- **F3112 Work Order Routing Instructions**
  - Work Center
  - Operations Sequence
  - Estimated Labour Hours
  - Estimated Labour Cost (Hours * Rate calculation)

- **F0911 General Ledger**
  - Actual Labour Hours (Doc Type = T4)
  - Actual Labour Cost (Doc Type = T4)
  - Actual Materials Cost (Doc Type = II)
  - Actual Other Cost (Doc Type <> T2, T4, or II)
  - Actual Total Cost (Doc Type <> T2)

- **Calculated Report Column**
  - Labour Hour Variance (Actual Labour Hours – Estimated Labour Hours)
  - Labour Cost Variance (Actual Labour Cost – Estimated Labour Cost)
  - Materials Cost Variance (Actual Materials Cost – Estimated Materials Cost)
  - Total Variance (Actual Total Cost – Estimated Total Cost)

Data Sort & Totaling

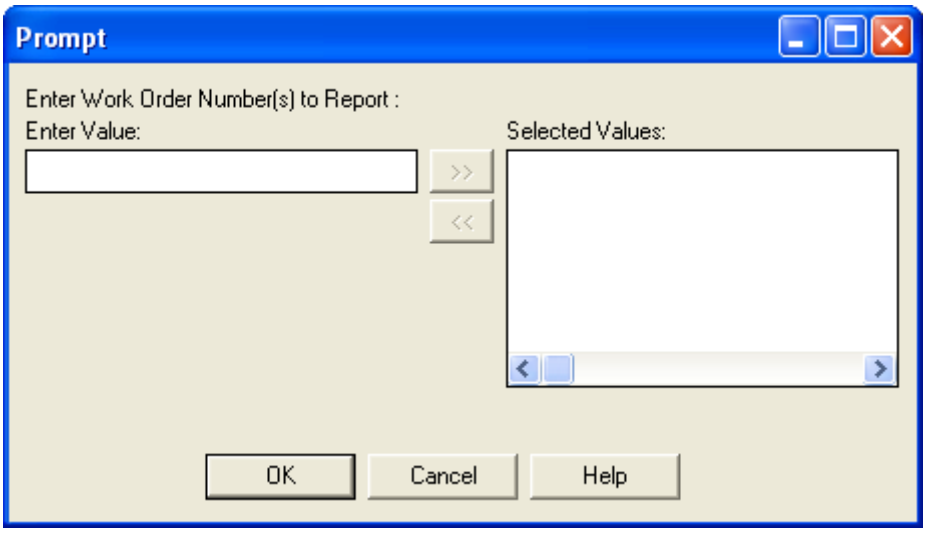
- The report returns records for a specific Work Order or group of Work Orders sorted in ascending order by Work Order number.

  - Note: The SQL statement used by this report differs from that used by standard Showcase Strategy reports. This is due to the nature of the incoming report data, specifically the (many to many) relationship between tables. Therefore, the ability to perform extensive sorting may be limited.

- Data is grouped and totaled by (1) Work Order.

Report Execution

Upon execution the report will prompt the user to supply a value(s) for one condition.



- The prompt requests one or more numeric (Max. 8 digit) value(s) representing the Work Order(s) for which the report is to be executed. This value corresponds with the value contained by the Work Order's master record.

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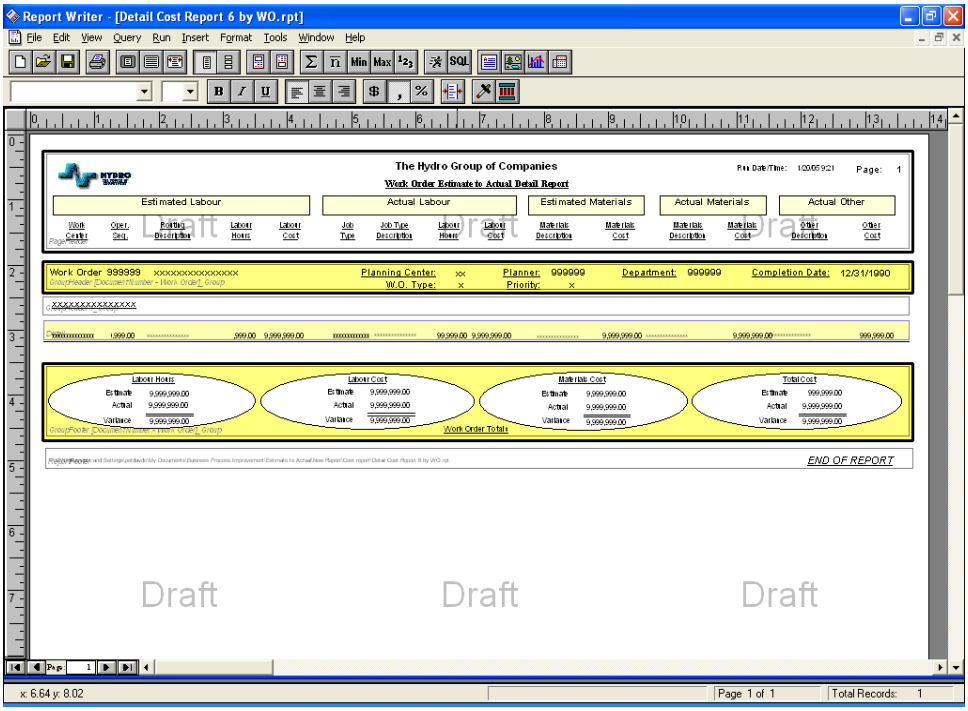
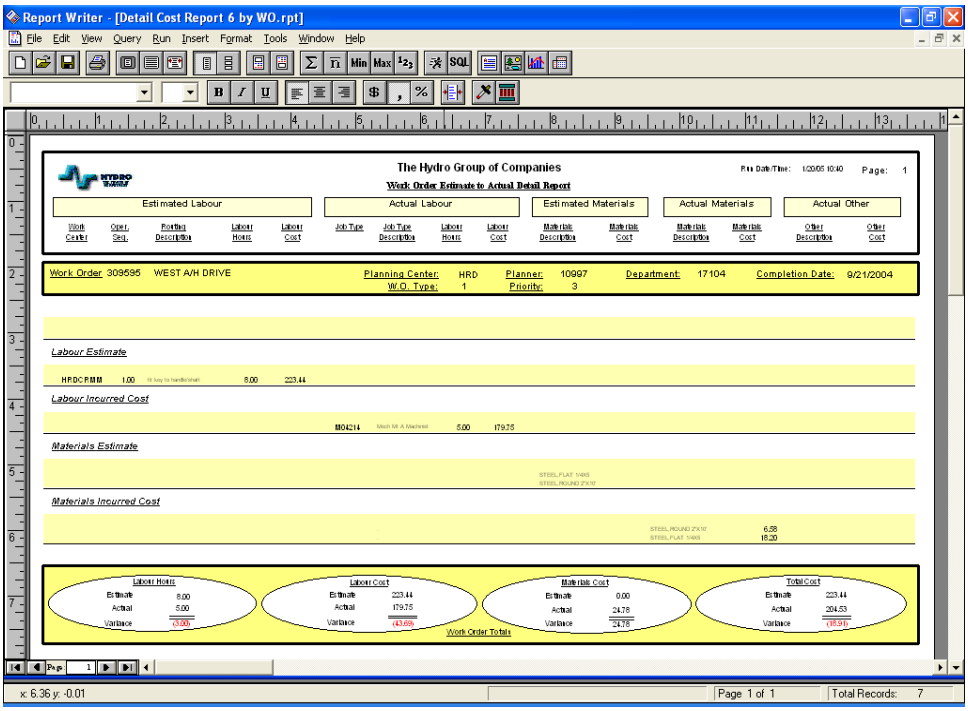
Sample Report Screen Shots





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Report Query Select Statement

```
SELECT
WAWR10 AS COLUMN0001,
WAANSA AS COLUMN0002,
WAANPA AS COLUMN0003,
Date( WASTRX, CYYDDD ) AS COLUMN0004,
WADOCO AS COLUMN0005,
WADL01 AS COLUMN0006,
WAAMTO AS COLUMN007,
0 - WAAMTO AS COLUMN0008,
' ' AS COLUMN0009,
' ' AS COLUMN0010,
0 AS COLUMN0011,
0 AS COLUMN0012,
0 AS COLUMN0013,
' ' AS COLUMN0014,
0 AS COLUMN0015,
' ' AS COLUMN0016,
' ' AS COLUMN0017,
' ' AS COLUMN0018,
0 AS COLUMN0019,
0 AS COLUMN0020,
0 AS COLUMN0021,
0 AS COLUMN0022,
0 AS COLUMN0023,
1 AS COLUMN0024,
' ' AS COLUMN0025,
' ' AS COLUMN0026,
0 AS COLUMN0027,
0 AS COLUMN0028,
0 AS COLUMN0029,
WATYPS AS COLUMN0030,
WAPRTS AS COLUMN0031

FROM
PRDDTA.F4801 F4801

WHERE
WADOCO IN (&Wonbr)
```

```
GROUP BY
WAWR10,
WAANSA,
WAANPA,
WASTRX,
WADOCO,
WADL01,
WATYPS,
WAPRTS,
WAAMTO,
0 - WAAMTO

UNION SELECT
WAWR10 AS COLUMN0001,
WAANSA AS COLUMN0002,
WAANPA AS COLUMN0003,
Date( WASTRX, CYYDDD ) AS COLUMN0004,
WADOCO AS COLUMN0005,
WADL01 AS COLUMN0006,
0 AS COLUMN0007,
0 AS COLUMN0008,
WLMCU AS COLUMN0009,
WLDSC1 AS COLUMN0010,
WLOPSQ AS COLUMN0011,
WLRUNL AS COLUMN0012,
WLRUNL * WLPWRT AS COLUMN0013,
' ' AS COLUMN0014,
0 AS COLUMN0015,
' ' AS COLUMN0016,
' ' AS COLUMN0017,
' ' AS COLUMN0018,
0 AS COLUMN0019,
0 AS COLUMN0020,
0 AS COLUMN0021,
0 AS COLUMN0022,
0 AS COLUMN0023,
2 AS COLUMN0024,
'Labour Estimate' AS COLUMN0025,
' ' AS COLUMN0026,
0 - WLRUNL AS COLUMN0027,
```

```
0 - WLRUNL * WLPWRT AS COLUMN0028,
0 AS COLUMN0029,
WATYPS AS COLUMN0030,
WAPRTS AS COLUMN0031

FROM
PRDDTA.F4801 F4801,
PRDDTA.F3112LA F3112LA

WHERE
F4801.WADOCO = F3112LA.WLDOCO
AND WADOCO IN (&Wonbr)

GROUP BY
WAWR10,
WAANSA,
WAANPA,
WASTRX,
WADOCO,
WADL01,
WATYPS,
WAPRTS,
WLMCU,
WLDSC1,
WLOPSQ,
WLRUNL,
WLRUNL * WLPWRT,
0 - WLRUNL,
0 - WLRUNL * WLPWRT

UNION SELECT
WAWR10 AS COLUMN0001,
WAANSA AS COLUMN0002,
WAANPA AS COLUMN0003,
Date( WASTRX, CYYDDD ) AS COLUMN0004,
WADOCO AS COLUMN0005,
WADL01 AS COLUMN0006,
0 AS COLUMN0007,
0 AS COLUMN0008,
' ' AS COLUMN0009,
' ' AS COLUMN0010,
```

```
0 AS COLUMN0011,
0 AS COLUMN0012,
0 AS COLUMN0013,
WMDSC1 AS COLUMN0014,
WMUORG * WMEA AS COLUMN0015,
' ' AS COLUMN0016,
' ' AS COLUMN0017,
' ' AS COLUMN0018,
0 AS COLUMN0019,
0 AS COLUMN0020,
0 AS COLUMN0021,
0 AS COLUMN0022,
0 AS COLUMN0023,
4 AS COLUMN0024,
'Materials Estimate' AS COLUMN0025,
' ' AS COLUMN0026,
0 AS COLUMN0027,
0 AS COLUMN0028,
0 - WMUORG * WMEA AS COLUMN0029,
WATYPS AS COLUMN0030,
WAPRTS AS COLUMN0031

FROM
PRDDTA.F4801 F4801,
PRDDTA.F3111LA F3111LA
WHERE
F4801.WADOCO = F3111LA.WMDOCO
AND WADOCO IN (&Wonbr)

GROUP BY
WAWR10,
WAANSA,
WAANPA,
WASTRX,
WADOCO,
WADL01,
WATYPS,
WAPRTS,
WMDSC1,
WMUORG * WMEA,
0 - WMUORG * WMEA
```

```
UNION SELECT
WAWR10 AS COLUMN0001,
WAANSA AS COLUMN0002,
WAANPA AS COLUMN0003,
Date( WASTRX, CYYDDD ) AS COLUMN0004,
WADOCO AS COLUMN0005,
WADL01 AS COLUMN0006,
0 AS COLUMN0007,
SUM ( CASE
WHEN GLDCT <> 'T2' THEN GLAA
END ) - 0 AS COLUMN0008,
' ' AS COLUMN0009,
' ' AS COLUMN0010,
0 AS COLUMN0011,
0 AS COLUMN0012,
0 AS COLUMN0013,
' ' AS COLUMN0014,
0 AS COLUMN0015,
GLJBCD AS COLUMN0016,
" GLJBCD01" AS COLUMN0017,
CASE
WHEN GLDCT = 'II'
THEN GLEXR
END AS COLUMN0018,
SUM ( CASE
WHEN GLDCT = 'T4' THEN GLU
END ) AS COLUMN0019,
SUM ( CASE
WHEN GLDCT = 'T4' THEN GLAA
END ) AS COLUMN0020,
SUM ( CASE
WHEN GLDCT = 'II' THEN GLAA
END ) AS COLUMN0021,
SUM ( CASE
WHEN GLDCT <> 'T2' AND GLDCT <> 'T4' AND GLDCT <> 'II' THEN GLAA
END ) AS COLUMN0022,
SUM ( CASE
WHEN GLDCT <> 'T2' THEN GLAA
END ) AS COLUMN0023,
CASE
```

```
WHEN GLDCT = 'T4' THEN 3
WHEN GLDCT = 'II' THEN 5
WHEN GLDCT <> 'T2' AND GLDCT <> 'T4' AND GLDCT <> 'II' THEN 6
END AS COLUMN0024,
CASE
WHEN GLDCT = 'T4' THEN 'Labour Incurred Cost'
WHEN GLDCT = 'II' THEN 'Materials Incurred Cost'
WHEN GLDCT <> 'T2' AND GLDCT <> 'T4' AND GLDCT <> 'II'
THEN 'Other Incurred Cost'
END AS COLUMN0025,
CASE
WHEN GLDCT <> 'T2' AND GLDCT <> 'T4' AND GLDCT <> 'II'
THEN GLEXR
END AS COLUMN0026,
SUM ( CASE
WHEN GLDCT = 'T4' THEN GLU
END ) - 0 AS COLUMN0027,
SUM ( CASE
WHEN GLDCT = 'T4' THEN GLAA
END ) - 0 AS COLUMN0028,
SUM ( CASE
WHEN GLDCT = 'II' THEN GLAA
END ) - 0 AS COLUMN0029,
WATYPS AS COLUMN0030,
WAPRTS AS COLUMN0031

FROM
PRDDTA.F4801 F4801,
PRDDTA.F0911LK F0911LK

WHERE
DIGITS( F4801.WADOCO ) = F0911LK.GLSBL
AND WADOCO IN (&Wonbr)
AND ( GLSBLT = 'W'
AND GLDCT <> 'T2')

GROUP BY
WAWR10,
WAANSA,
WAANPA,
WASTRX,
```

WADOCO,
WADL01,
WATYPS,
WAPRTS,
GLJBCD,
GLEXR,
GLDCT

ORDER BY
5,
24

Work Order Compliance with Estimates

Introduction

This document is intended to provide a functional specification for measuring Work Order Compliance with Estimates The Primary purpose of this Metric is to provide a means to measure how well we execute the our Estimates. The report maximizes Showcase report writer as the tool. The BPI Work Execution Team has in advance provided the criteria to develop this report. The report provides information that can be used to measure estimates of labor cost/hours and estimated material cost versus actual labor cost/hours and actual material cost.

Data Sources

The report returns data from the following tables and columns contained in JD Edwards.

- **F4801 - Work Order Master File**
- **F0618 - Payroll Transaction History File**
- **F3112 – Shop Floor Control Routing Instructions**
  - **Order Type**
  - **Work Order Number**
  - **Parent Work Order**
  - **Type Work Order**
  - **Priority – Work Order**
  - **Description of Work Order**
  - **Company**
  - **Business Unit**
  - **Location**

- **Status of Work Order**
- **Start date**
- **Completion Date**
- **Estimated Hours**
- **Asset Number**
- **Amount – Actual Material**
- **Unit or Tag Number**
- **Supervisor Number**
- **Originator of Work Order**
- **Manager Address Number**
- **Assigned to**
- **Planning Center – Region**
- **Amount Estimated**

Query Properties

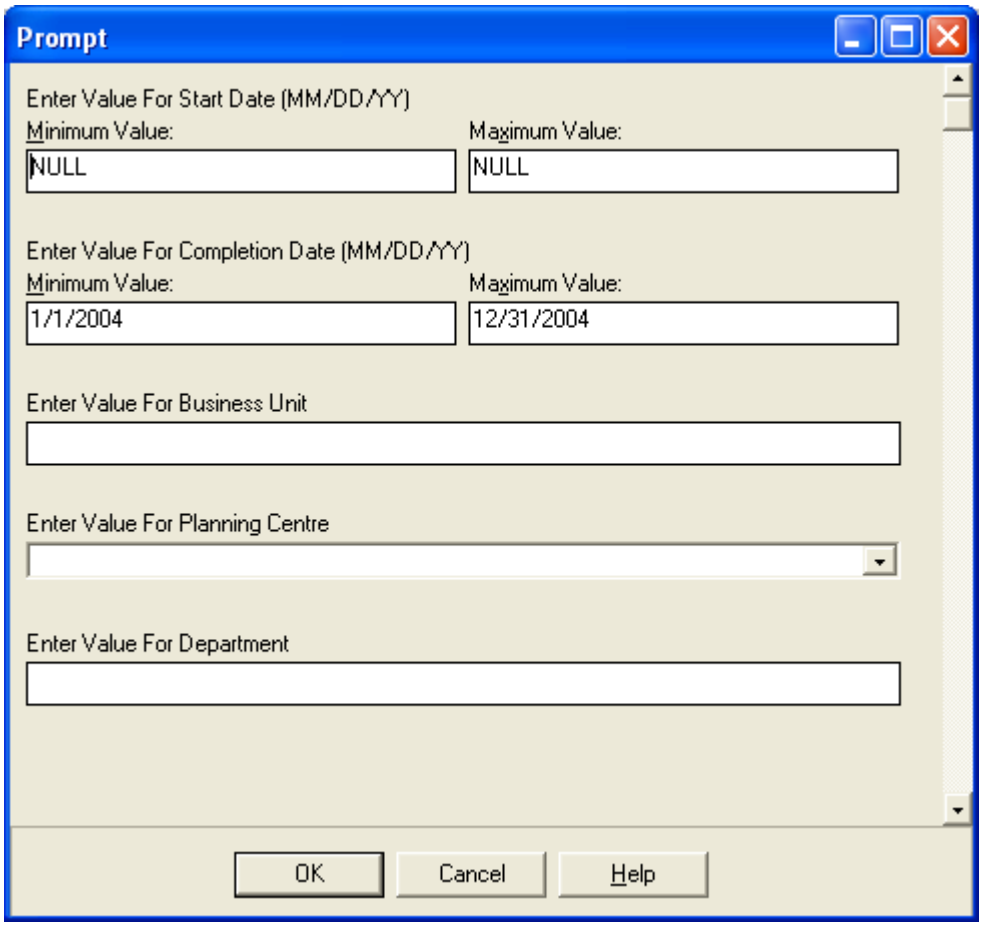
Conditions that are added to this report are as follows:

- ✓ Start date – Prompt
- ✓ Completion date – Prompt
- ✓ Business Unit – Prompt
- ✓ Region – Prompt
- ✓ Department number – Prompt
- ✓ Work Order Type – Prompt

Report Execution

When executing the report you may enter the fields as required:

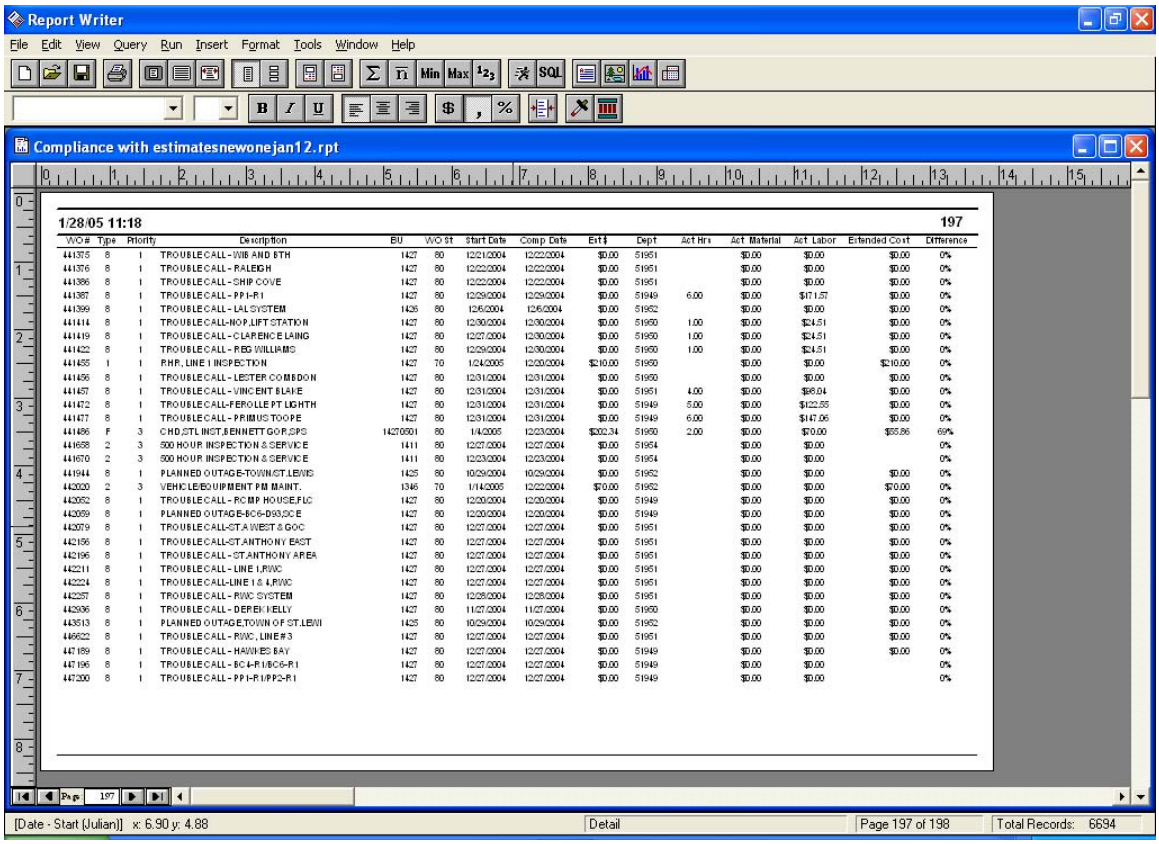
- ➢ Start date – The last date remains until changed
- ➢ Completion Date - The last date remains until changed
- ➢ Business Unit – Enter a Valid Business Unit
- ➢ Department number – Enter a Valid Department number
- ➢ Work Order Type – Enter a Valid Work Type
- ➢ Planning Center – Either use the pull down menu or type a Valid Region



Select RUN to Execute
This report takes approximately 2 minutes and 30 seconds to run.

The Results are below.

Newfoundland & Labrador Hydro Group of Companies



Metric Title: **% Emergency Person Hours Worked**

Metric Background:
Operating in a reactive environment is an obstacle for implementing and using the work execution process. Emergency person hours are all the hours charged to priority #1 work orders. Priority #1 work orders are work orders of high importance and high urgency as outlined in the Routine Work Order Prioritization Guide. This metric provides a clear picture of whether we're operating in a reactive or proactive environment. Spending more than 10% of total person hours on priority work is an indicator that one is in a reactive mode and is normally a symptom of deeper problems.

Metric Definition:
% Emergency Person Hours Worked

$$\frac{\text{Person hours spent on emergency work (priority \#1 wo's)}}{\text{Total Person Hours Worked on all Work Hours}} \times 100$$

Supporting Information:
This metric is generated based on a specified time frame.
Example: January 1, 2005 thru March 31, 2005.

The metric is based on completed work orders (status 70 thru 95)

Prompts must include planning center, business unit, section or dept, start/completion dates.

Frequency of Generation:
This metric must be generated quarterly and at year end.

Note: Ensure metric is generated two weeks after generation date to capture latest timesheet entry data.

Generated by:
The Planning Superintendent, Planning Supervisor or designate.

Target:
Industry average for time worked on priority 1 work orders (emergency work) is 10% or less. Division/Plant sets targets annually as part of goals and objectives.

% Emergency Person Hours Worked

Introduction

Operating in a proactive mode is key for planning and scheduling work. If a major portion of time is spent doing emergency type work, then in all likelihood, planning and scheduling will not be as successful as it should be. Measuring the amount of time spend on emergency work is a good measure to determine the mode of operation (i.e. reactive mode vs. proactive mode). Operating in a reactive mode is usually a symptom of deeper problems.

Emergency hours are a measure of the number of person hours spent doing emergency work as compared to total hours worked. Emergency work is defined as work that must begin now (Priority #1).

Data Sources

The report returns data from the following Tables and Columns contained in JD Edwards:

- **F4801 - Work Order Master File**
- **F0618 - Payroll Transaction History File**
- **F3112 – Shop Floor Control Routing Instructions**
  - **Order Type**
  - **Work Order Number**
  - **Type Work Order**
  - **Priority – Work Order**
  - **Description of Work Order**
  - **Business Unit**
  - **Location**
  - **Status of Work Order**
  - **Address Number**
  - **Supervisor**
  - **Start Date**
  - **Completion date**
  - **Planning Center**
  - **Amount Estimated**
  - **Hours Estimated**
  - **Sum of Hours Worked**
  - **DBA Code**
  - **Amount Actual Labor**

Query Properties

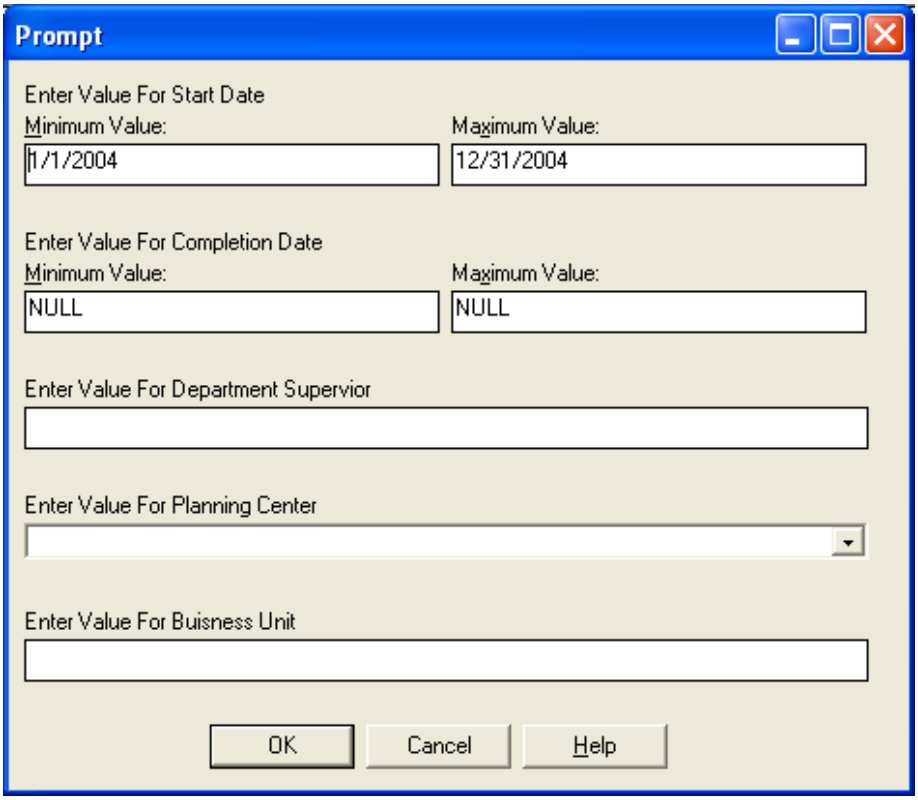
Conditions that are preset are as follows:

DBA Code is less than or equal to 250
Status code is between 10 90

Report Execution

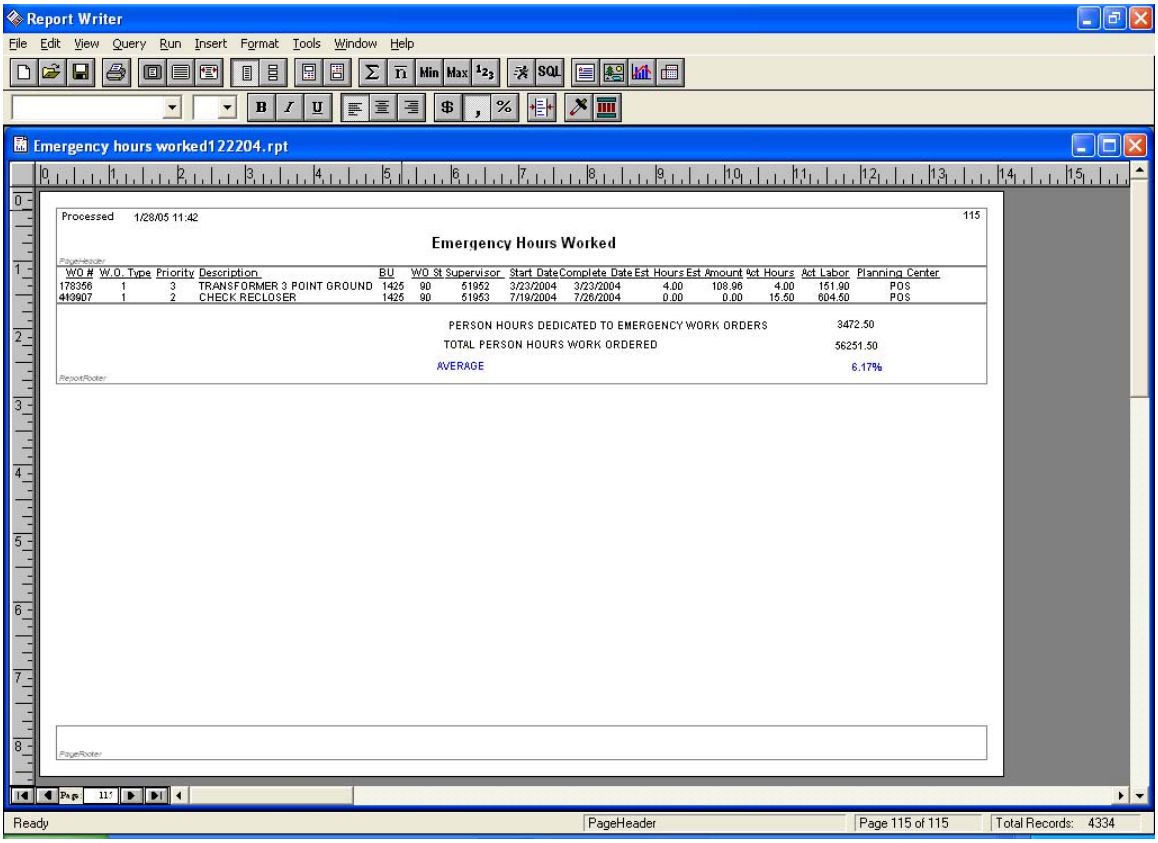
When executing the report you MAY enter the field as required:

- ✓ Start Date
- ✓ Completion Date
- ✓ Department Supervisor
- ✓ Planning Center
- ✓ Business Unit



Once entered you now select Run to Execute

Newfoundland & Labrador Hydro
Group of Companies



Newfoundland & Labrador Hydro
Group of Companies

Metric Title: **% Planned Person Hours Worked**

Metric Background:
Operating in a planned environment is key for the work execution process. Planned person hours are the hours charged to priority #3 and #4 work orders; work orders that should be properly planned and scheduled. Most companies aim to spend 90% plus on planned work. This metric is intended to provide a snapshot of their mode of operation.

Metric Definition:
% Planned Person Hours Worked

$$\frac{\text{Person hours spent planned work (priority \#3 \&\#4 work orders)}}{\text{Total person hours worked on all work hours}} \times 100$$

Supporting Information:

This metric is generated based on a specified time frame.
Example: January 1, 2005 thru March 31, 2005.

The metric is based on completed work orders (status 70 thru 95)

Planned work orders are priority #3 and #4 work orders only..

Prompts must include Planning Center, Business Unit, Section/Dept and start/end dates.

Frequency of Generation:
This metric can be generated on demand but must be generated and documented quarterly and year end.

Note: Generate metric two (2) weeks after generation due date to ensure latest timesheet data is captured.

Generated by:
The Planning Superintendent, Planning Supervisor or designate.

Target:
Industry average for time worked on planned work orders is 90%.

% Planned Person Hours Worked

Introduction

This document is intended to provide a specification for executing a report for measuring the percentage of time spent on planned work (priority #3 and #4) versus unplanned work (priority #1 and #2). The BPI Work Execution Team has in advance provided the criteria to develop this report

Data Sources

The report returns data from the following tables and columns contained in JD Edwards.

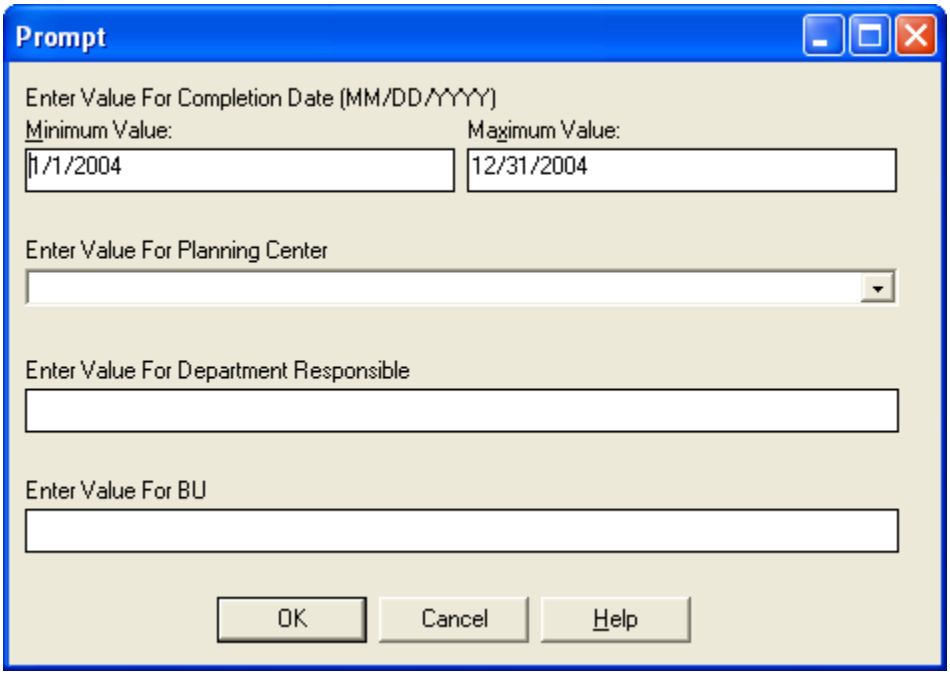
- **F4801 - Work Order Master File**
- **F0618 - Payroll Transaction History File**
  - Address Number
  - Alpha Name
  - Business Unit
  - Sub ledger (Work Order)
  - Description
  - Order Type
  - DBA Code
  - Hours Worked
  - Type of Work Order
  - Priority – Work Order
  - Status of Work Order
  - Supervisor
  - Planning Center
  - Start Date
  - Completion Date
  - Craft

Query Properties

Embedded in the code for this report is the following:

Status of Work order is “IN” 70, 80, and 90
DBA code is less than or equal to 223

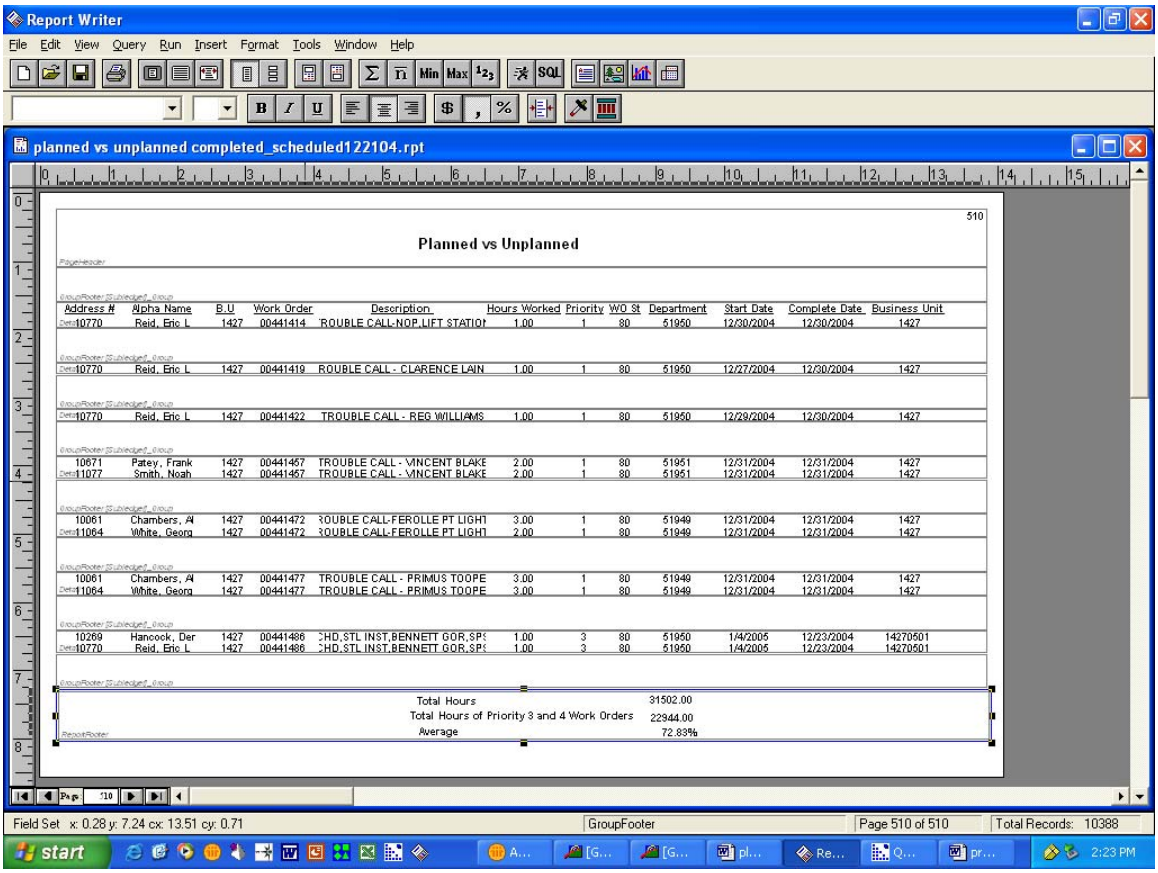
Report Execution



1. Enter the Completion date in which to query
2. Enter the Planning Center
3. Enter the Department responsible
4. Enter a Valid Business Unit

Select Run to Execute

Newfoundland & Labrador Hydro Group of Companies



Newfoundland & Labrador Hydro
Group of Companies

Metric Title: **% Preventive Maintenance Coverage**

Metric Background:
While correcting equipment failures efficiently and effectively is important, anticipating and heading off failures is also a major part of the maintenance management program. Preventive maintenance concerns itself with keeping equipment from failing in the first place. This should be the principal focus of any work force. As preventive maintenance is such an important part of the maintenance program, it's important to be able to measure the amount of time dedicated to this work so we can properly benchmark against like industries. This metric must not be confused with % pm compliance which actually compares the number of pm inspections to the number completed.

Metric Definition:
% Preventive Maintenance Coverage

$$\frac{\text{Person hours spent on preventive maintenance (type 2) work orders}}{\text{Total person hours worked on all work hours}} \times 100$$

Supporting Information:
This metric is generated based on a specified time frame.
Example: January 1, 2005 thru December 31, 2005.

The metric is based on type 2 completed work orders (status 70 thru 95)

Prompts must include Planning Center, Section/Dept, Craft Code and Start and End Dates.

Frequency of Generation:
This metric can be generated on demand but must be generated and documented annually.

Generation #1Period January 1st thru December 31st

Note: Ensure metric is generated two weeks after generation date to capture latest timesheet entry data.

Generated by:
The Planning Superintendent, Planning Supervisor or designate.

Target:
Industry average is 30% or greater.

Division / Plant target to be determined and set as part of annual goals and objectives.

% Preventative Maintenance Coverage

Introduction

While correcting equipment failures efficiently and effective is important, anticipating and heading off failures is also a major part of the maintenance management program. Preventive maintenance concerns itself with keeping equipment from failing in the first place. This should be the principal focus on any work force. As preventive maintenance is such an important part of the maintenance program, it's important to be able to measure the amount of time dedicated to this work so we can properly benchmark against like industries. This document is intended to provide a functional specification for measuring Preventive Maintenance Coverage. Inputs, interfaces and expected outputs will be identified in this document.

Data Sources

The report returns data from the following Tables and Columns contained in JD Edwards:

- **F4801 - Work Order Master File**
- **F0618 - Payroll Transaction History File**
- **F3112 – Shop Floor Control Routing Instructions**
  - **Order Type**
  - **Work Order Number**
  - **Type Work Order**
  - **Priority – Work Order**
  - **Description of Work Order**
  - **Business Unit**
  - **Location**
  - **Status of Work Order**
  - **Address Number**
  - **Supervisor**
  - **Start Date**
  - **Completion date**
  - **Planning Center**

- **Amount Estimated**
- **Hours Estimated**
- **Sum of Hours Worked**
- **DBA Code**
- **Amount Actual Labor**
- **Craft**

Query Properties

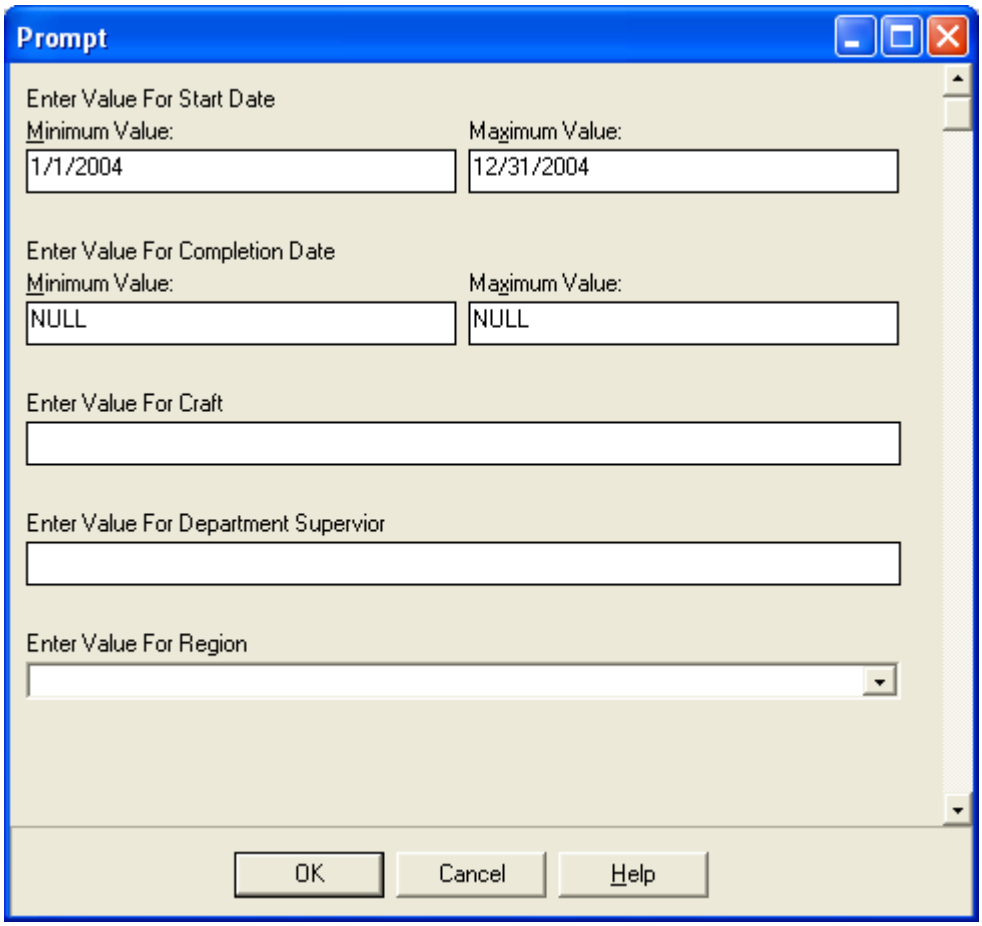
Conditions that are preset are as follows:

DBA Code is less than or equal to 250
Status code is between 10 90

Report Execution

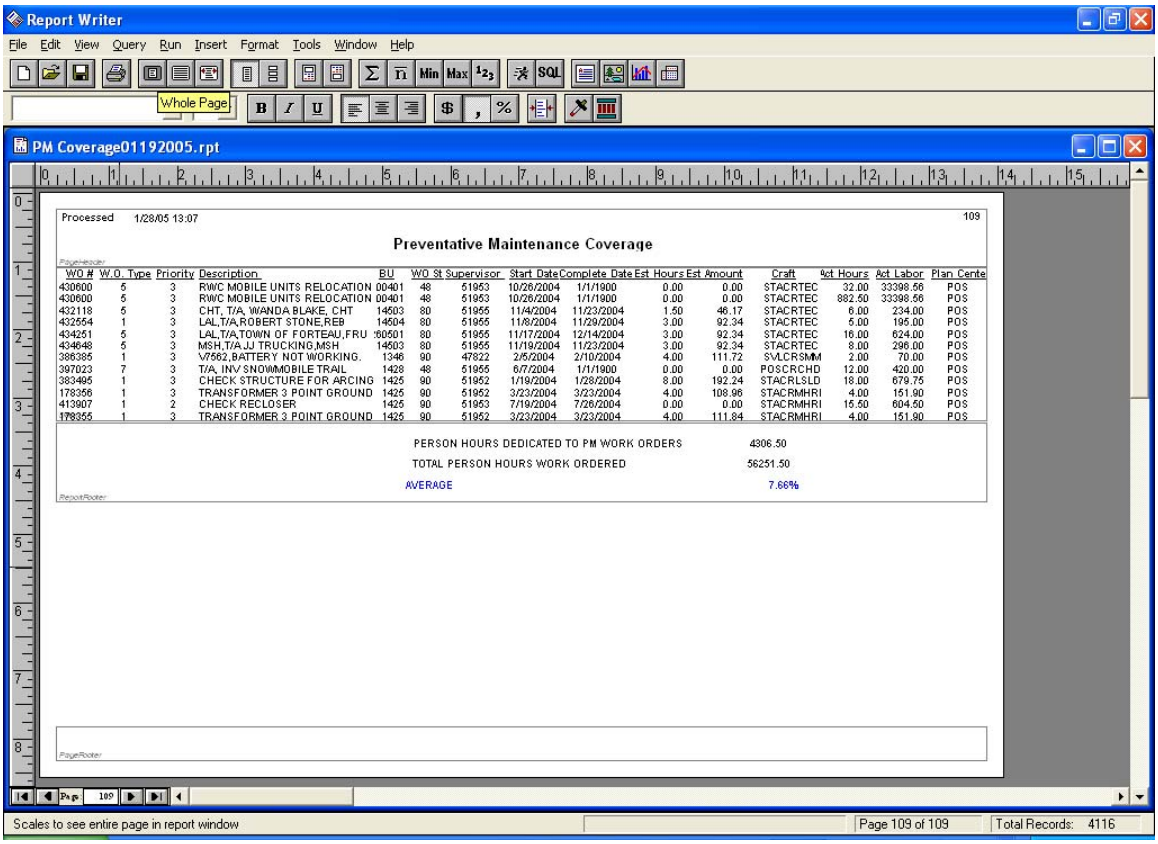
When executing the report you MAY enter the field as required:

- ✓ Start Date
- ✓ Completion Date
- ✓ Craft
- ✓ Department Supervisor
- ✓ Planning Center
- ✓ Business Unit



Once entered you now select Run to Execute

Newfoundland & Labrador Hydro Group of Companies



Newfoundland & Labrador Hydro
Group of Companies

% Compliance with annual work plan types

- **Preventive Maintenance**
  - **Capital Projects**
  - **Operating Projects**
  - **Non-Maintenance**
    - **Corrective**

Metric Title: **% Preventive Maintenance Compliance**

Metric Background:
Preventive Maintenance is extremely important as it is intended to predict or find failures before they occur. Preventive Maintenance is one of the five-work plan types that is include in the annual work plan. This metric is intended to measure how well we comply with this plan; it actually measures the number of pm inspections completed as compared to the number scheduled.

Metric Definition:
% Preventive Maintenance Compliance

$$\frac{\text{Preventive Maintenance Inspections Completed}}{\text{Preventive Maintenance Inspections Generated for Scheduling}} \times 100$$

Supporting Information:

Preventive maintenance inspections generated for scheduling are all pm work orders at status range 04 thru 91.

Preventive maintenance inspections completed are all pm work orders at status range 70 thru 95 excluding 91. .

Prompts must include planning center, business unit, section or dept, and start/completion dates.

Frequency of Generation:
This metric can be generated on demand but must be generated and documented four times during the year.

Generation #1Period	January 1st thru March 31st
Generation #2 Period	January 1st thru June 30th
Generation #3 Period	January 1st thru October 31st
Generation #4 Period	January 1st thru December 31st

Note: Ensure metric is generated two weeks after generation date to capture latest timesheet entry data.

Generated by:
The Planning Superintendent, Planning Supervisor or designate.

Target:
There is no industry average target available for this metric. Divisions/Plants will have to establish their own targets as part of their annual goals and objectives.

Metric Title: **% of Capital Projects Completed**

Metric Background:
The purpose of this metric is to measure the number of capital projects completed within a specified time frame as compared to the number scheduled.

Metric Definition:
% Capital Projects Completed.

$$\frac{\text{Capital Project Work Orders Completed}}{\text{Capital Project Work Orders Scheduled}} \times 100$$

Supporting Information:
This metric is generated based on a specified time frame.
Example: January 1, 2005 thru December 31, 2005.

Capital Project Work Orders scheduled = 5%

The metric is based on completed capital project work orders (type 5) at status 70 thru 90.

Prompts must include planning center, business unit, section or dept, start/completion dates.

Frequency of Generation:
This metric can be generated on demand but must be generated annually.

Note: Ensure metric is generated two weeks after generation date to capture latest timesheet entry data.

Generated by:
The Planning Superintendent, Planning Supervisor or designate.

Target:
Plant Division will set Targets.

Metric Title: **% of Operating Projects Completed**

Metric Background:
The purpose of this metric is to measure the number of projects completed within a specified time frame as compared to the number scheduled.

Metric Definition:
% Operating Projects Completed.

Operating Project Work Orders Completed) x 100
Operating Project Work Orders Scheduled.

Supporting Information:
This metric is generated based on a specified time frame.
Example: January 1, 2005 thru March 31, 2005.

Operating Projects Scheduled = 4%

The metric is based on completed project work orders (type 4) at status 70 thru 90.

Prompts must include planning center, business unit, section or dept, start/completion dates.

Frequency of Generation:
This metric can be generated on demand but must be generated annually.

Note: Ensure metric is generated two weeks after generation date to capture latest timesheet entry data.

Generated by:
The Planning Superintendent, Planning Supervisor or designate.

Target:
Industry average for time worked on priority 1 work orders (emergency work) is 10% or less.

Division/Plant sets targets annually as part of goals and objectives.

Metric Title: **% of Non-Maintenance Work Orders Completed**

Metric Background:
The purpose of this metric is to measure the number of non –maintenance work orders completed within a specified time frame as compared to the number scheduled in the annual work plan.

Metric Definition:
% Non-Maintenance Work Orders Completed

$$\frac{\text{Non-Maintenance Work Orders Completed}}{\text{Non-Maintenance Work Orders Scheduled}} \times 100$$

Supporting Information:
This metric is generated based on a specified time frame.
Example: January 1, 2005 thru December 31, 2005.

The metric is based on completed non-maintenance work orders (type 3) at status 70 thru 90.

Prompts must include planning center, business unit, section or dept, start/completion dates.

Frequency of Generation:
This metric can be generated on demand but must be generated and documented annually.

Note: Ensure metric is generated two weeks after generation date to capture latest timesheet entry data.

Generated by:
The Planning Superintendent, Planning Supervisor or designate.

Target:
Plant/Division will set Targets.

Compliance to Annual Work Plans

Introduction

Definition
Compliance to work plan types is a measure of the work plan type packages that come from WI&P and Work Budgets. These packages are corrective maintenance, preventative maintenance, non-maintenance, operating and capital projects.

Background
Work plan types are new to the Hydro Group and measuring how well we did with respect to these plans will provide an indication of where improvements can be made. Presently we budget and in most cases balanced our budgets but did we follow our work plan and hence achieve the justified strategic goals of the section, department and Company? Approved work plan types including budget will be provided for each Business Unit through the Work Identification and Prioritization and Work Budgets processes. Through the work execution process we aim to complete these plans on time at least cost while maintaining quality.

Scope
This document is intended to provide functional specification for measuring compliance to the work plan types.

Purpose
The primary purpose of the work plan type metric is to provide a means to measure how well we executed the work plan type packages.

Overview
Presently there are no work plan type packages from WI&P, this will be a new measure to see how the process is working.

Key Characteristics

There are several characteristics that the systems for measuring work plan types.

- The system must have flexible querying
- The system must be fast, flexible and easy to use.
- The system must be seamless, in that the user should not have to perform multiple functions to obtain the required information from JD Edwards.

Metric Specification

Evaluation of work Plans (PM,CM,OP,CP,NM)

Evaluation of Preventative Maintenance Work Plan

a. % = PM Inspections Completed / PM Inspections Scheduled x 100

b. Pm Budget Performance = Original Budget – Actual Budget / Original Budget x 100

Evaluation of Operating Projects Work Plan

a. % = Operating Projects Completed / Operating Projects Scheduled x 100

b. Operating Projects Budget Performance = Original Budget – Actual Budget / Original Budget x 100

Evaluation of Capital Projects Work Plan

a. % = Capital Projects Completed / Capital Projects Scheduled x 100

b. Capital Projects Budget Performance = Original Budget – Actual Budget / Original Budget x 100

Evaluation of Corrective Maintenance Work Plan

a. CM Budget Performance = Original Budget – Actual Budget / Original Budget x 100

Evaluation of NM Work Plan

a. % = Non Maintenance Work Completed / Non-Maintenance Work Scheduled x 100

b. Non Maintenance Budget Performance = Original Budget – Actual Budget / Original Budget x 100

Procedures

For Capital Projects, Non Maintenance Work Completed, PM Inspections Completed, and Operating Projects.

When inquiring on **Capital Projects**, you need to do the following:

- Enter a valid Business Unit I.E 13503
- Enter a Start Date 01/01/2003 – 12/31/2003 (This date will remain there until changed)
- Enter a Completion Date. If left blank **NULL** will appear, this reminds you that the last time you or someone else ran the report it was **NOT** used
- You now can enter a specific Asset number or leave blank to retrieve all. **This example does not have an Asset number entered**
- Enter a Planning Center. This is the Region that you are inquiring on. You can click on the arrow to see the list or type the appropriate 3-letter code for your Region. I.E. POS
- Select RUN to execute

When inquiring on **Non Maintenance Work completed**, you need to do the following:

- Enter a valid Business Unit I.E 1427
- Enter a Start Date 01/01/2004 – 12/31/2004 (This date will remain there until changed)
- Enter a Completion Date. If left blank **NULL** will appear, this reminds you that the last time you or someone else ran the report it was **NOT** used
- You now can enter a specific Asset number or leave blank to retrieve all. **This example does not have an Asset number entered**
- Enter a Planning Center. This is the Region that you are inquiring on. You can click on the arrow to see the list or type the appropriate 3-letter code for your Region. I.E. POS
- Select RUN to execute

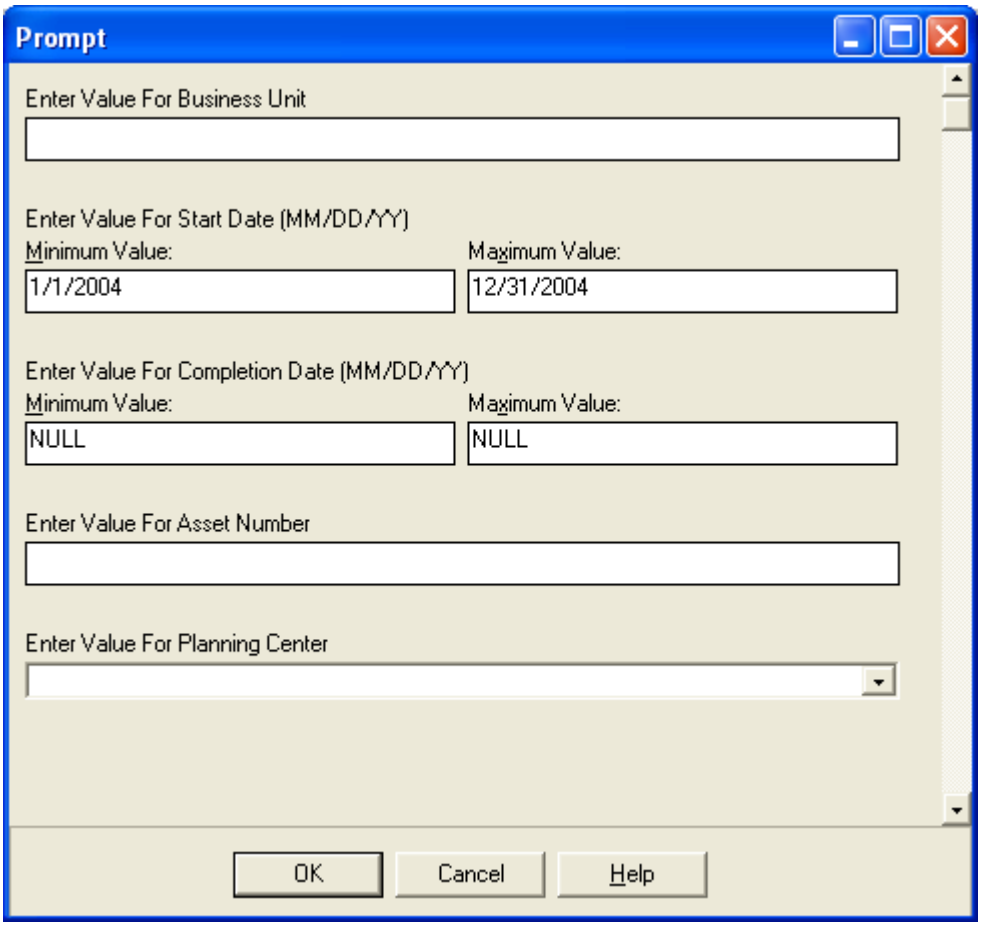
When inquiring on **PM Inspections Completed**, you need to do the following:

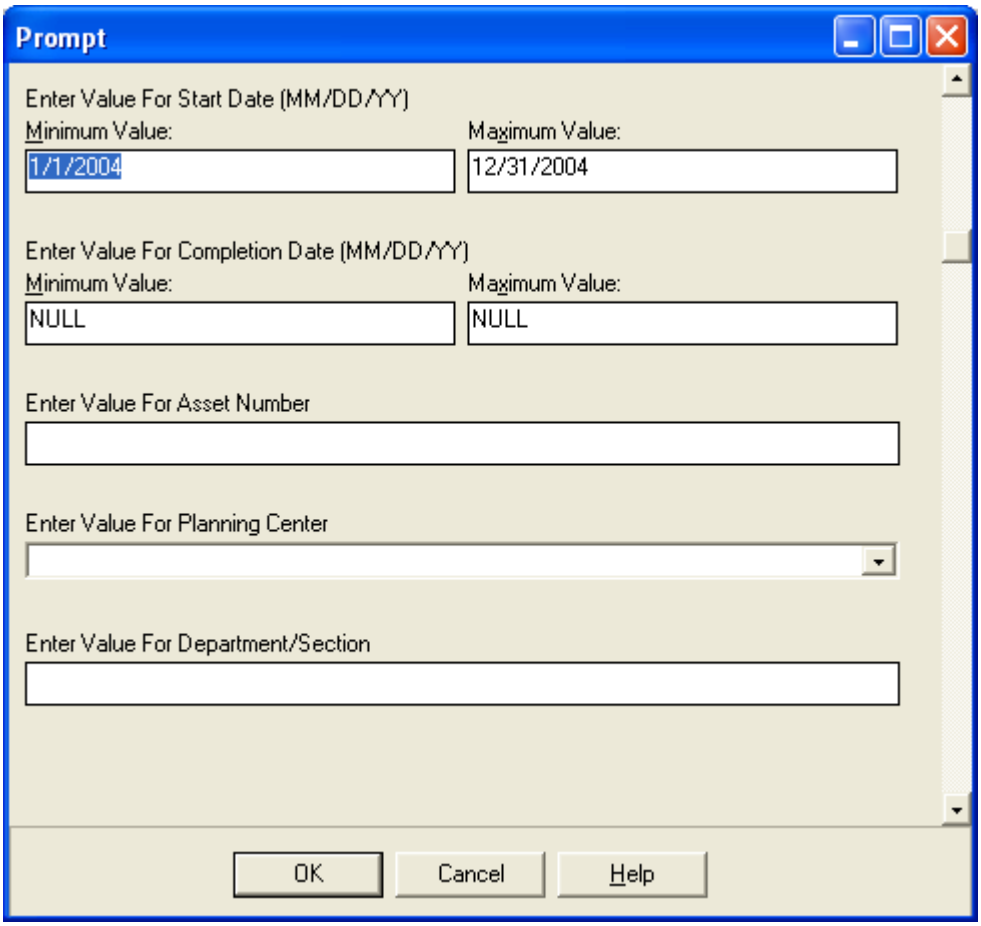
- Enter a valid Business Unit I.E 1391
- Enter a Start Date 01/01/2003 – 12/31/2003 (This date will remain there until changed)
- Enter a Completion Date. If left blank **NULL** will appear, this reminds you that the last time you or someone else ran the report it was **NOT** used

- You now can enter a specific Asset number or leave blank to retrieve all. **This example does not have an Asset number entered**
- Enter a Planning Center. This is the Region that you are inquiring on. You can click on the arrow to see the list or type the appropriate 3-letter code for your Region. I.E. HVY
- Select RUN to execute

When inquiring on **Operating Projects Completed**, you need to do the following:

- Enter a valid Business Unit I.E 1295
- Enter a Start Date 01/01/2003 – 12/31/2003 (This date will remain there until changed)
- Enter a Completion Date. If left blank **NULL** will appear, this reminds you that the last time you or someone else ran the report it was **NOT** used
- You now can enter a specific Asset number or leave blank to retrieve all. **This example does not have an Asset number entered**
- Enter a Planning Center. This is the Region that you are inquiring on. You can click on the arrow to see the list or type the appropriate 3-letter code for your Region. I.E. BDE
- Select RUN to execute

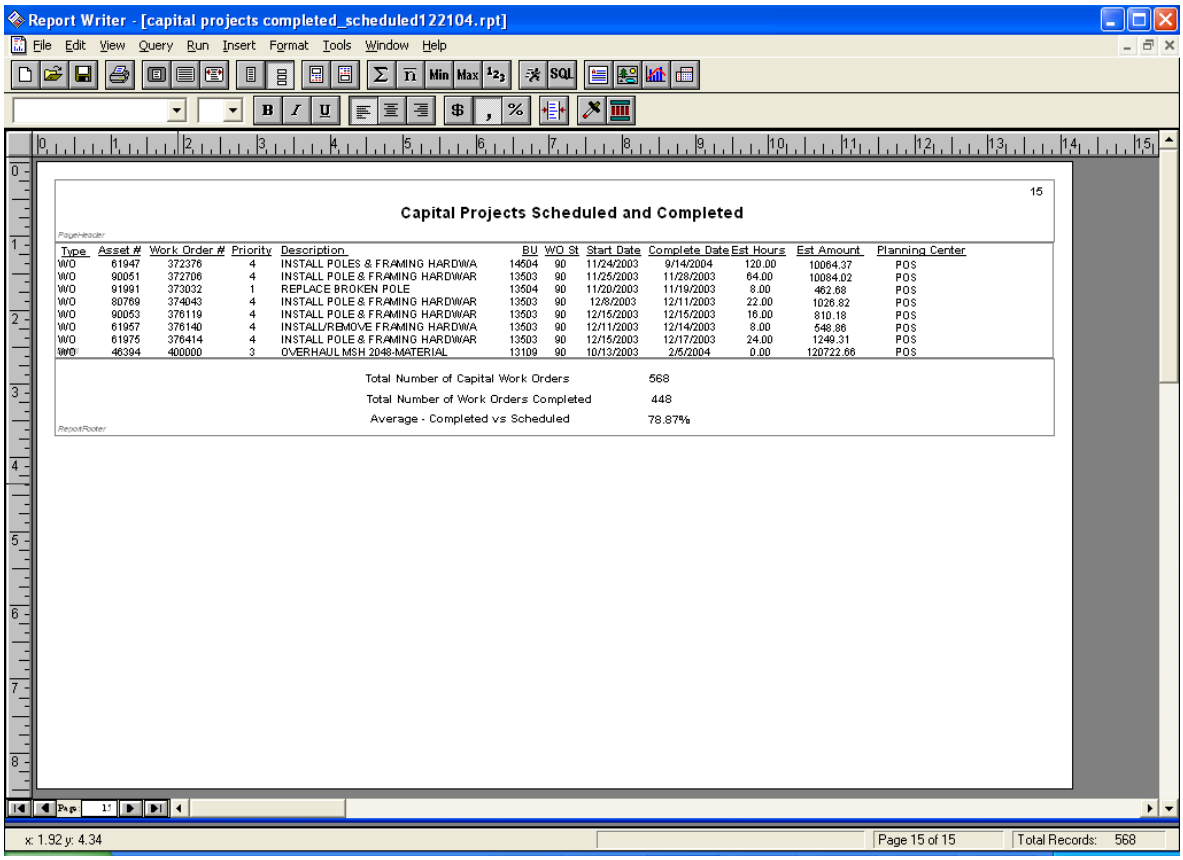

Prompt
Enter Value For Business Unit
Enter Value For Start Date (MM/DD/YY)
Minimum Value:
Maximum Value:
1/1/2004
12/31/2004
Enter Value For Completion Date (MM/DD/YY)
Minimum Value:
Maximum Value:
NULL
NULL
Enter Value For Asset Number
Enter Value For Planning Center
OK
Cancel
Help



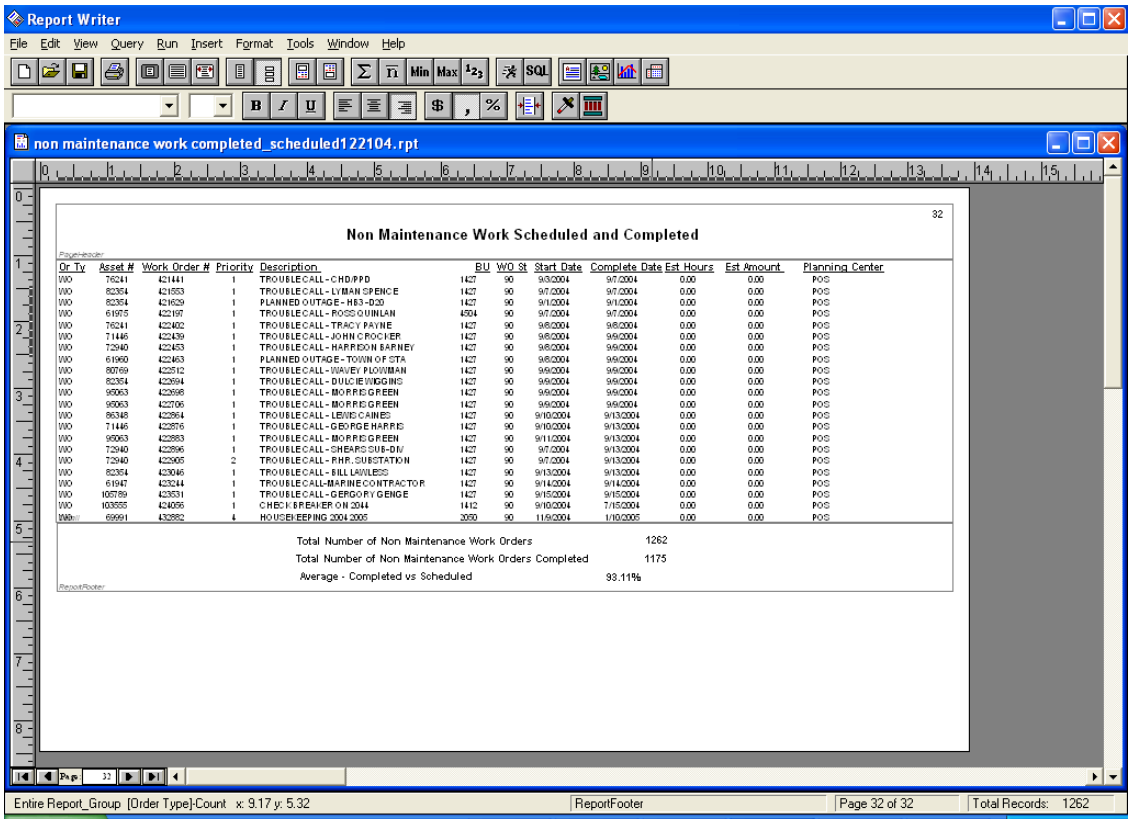
The results are listed below.

Newfoundland & Labrador Hydro
Group of Companies

Capital Projects



Non-Maintenance Work



Newfoundland & Labrador Hydro
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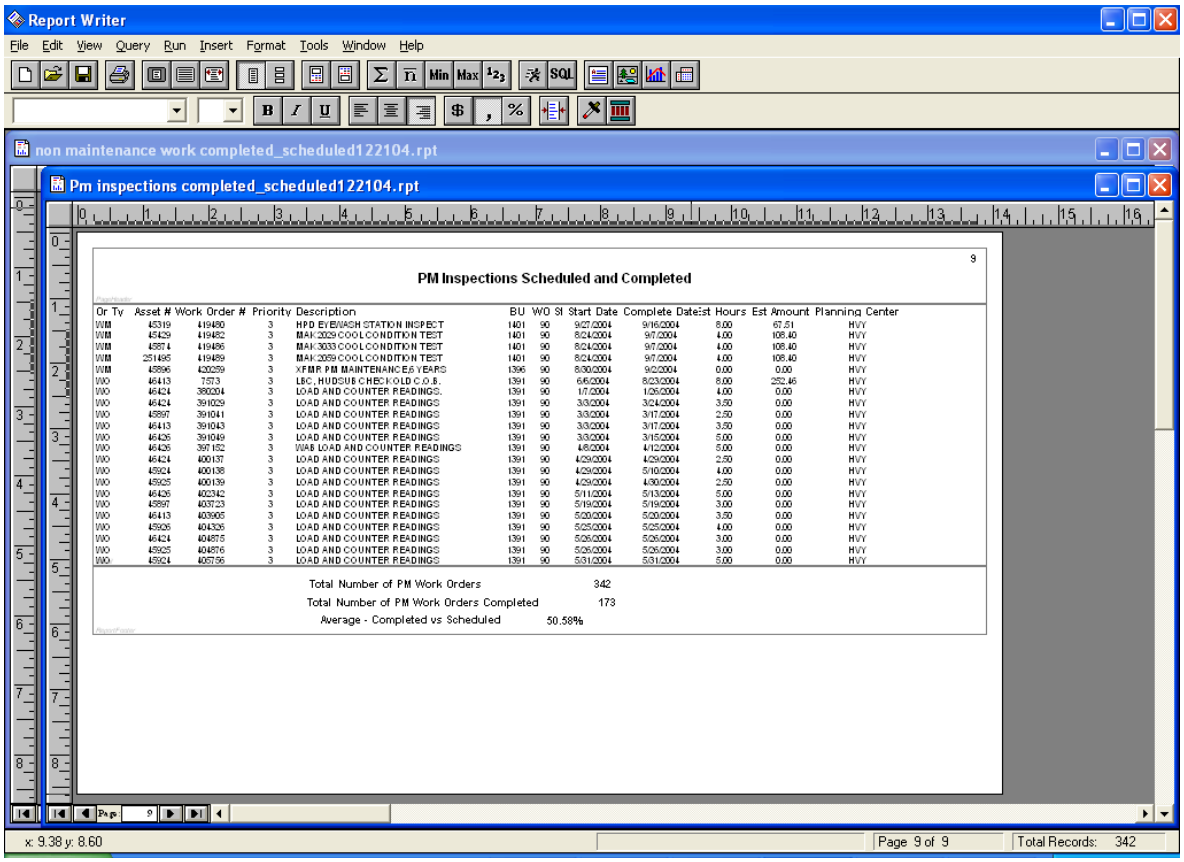
PM Inspections



Newfoundland & Labrador Hydro
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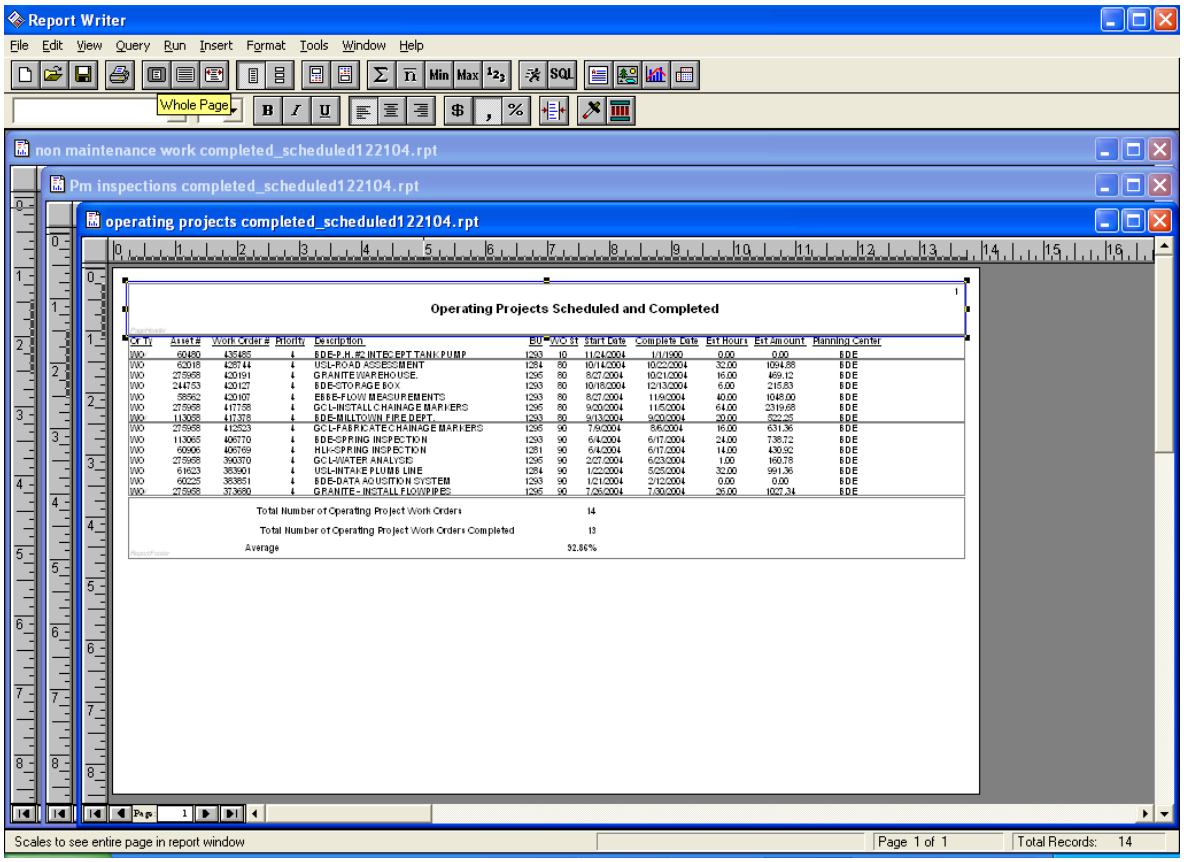
Operating Projects Completed



Newfoundland & Labrador Hydro
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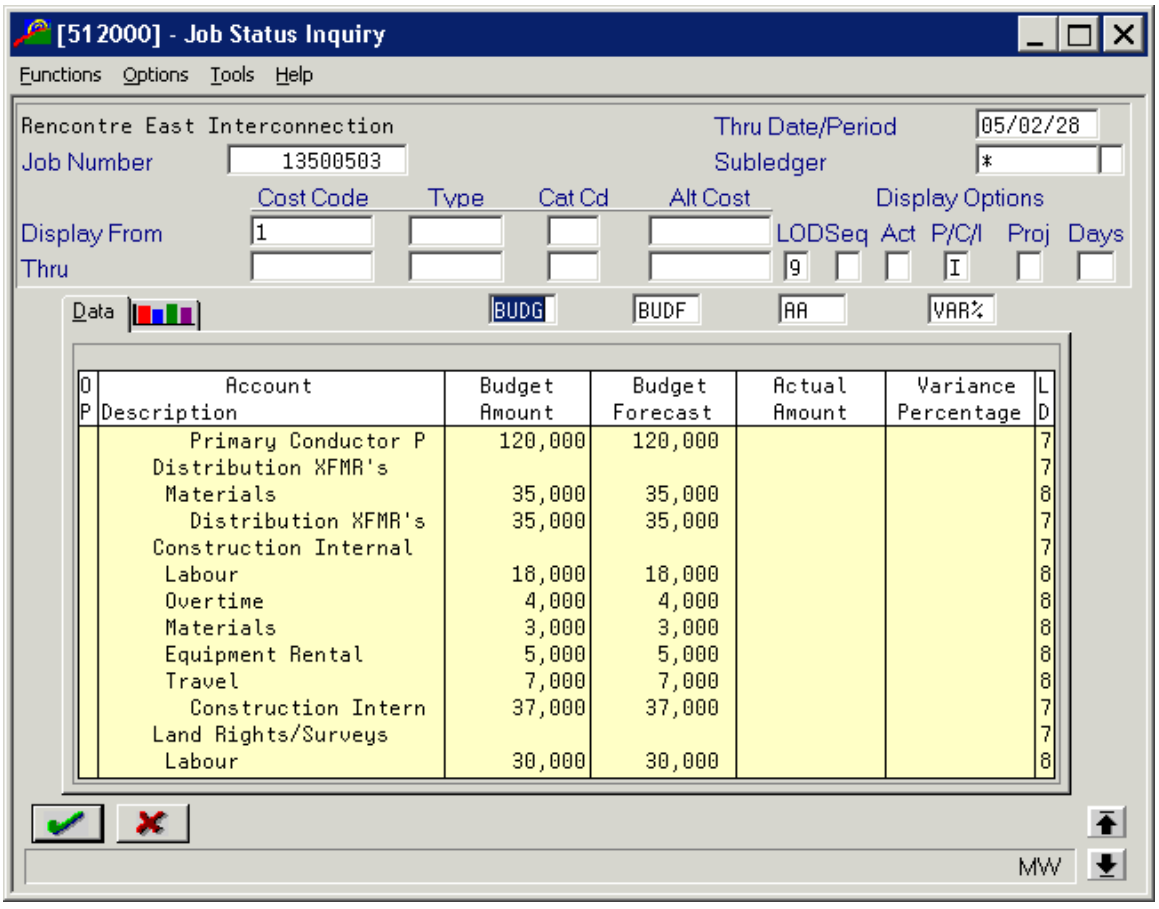
Metric Title: **Compliance to Work Plan Type Budgets**

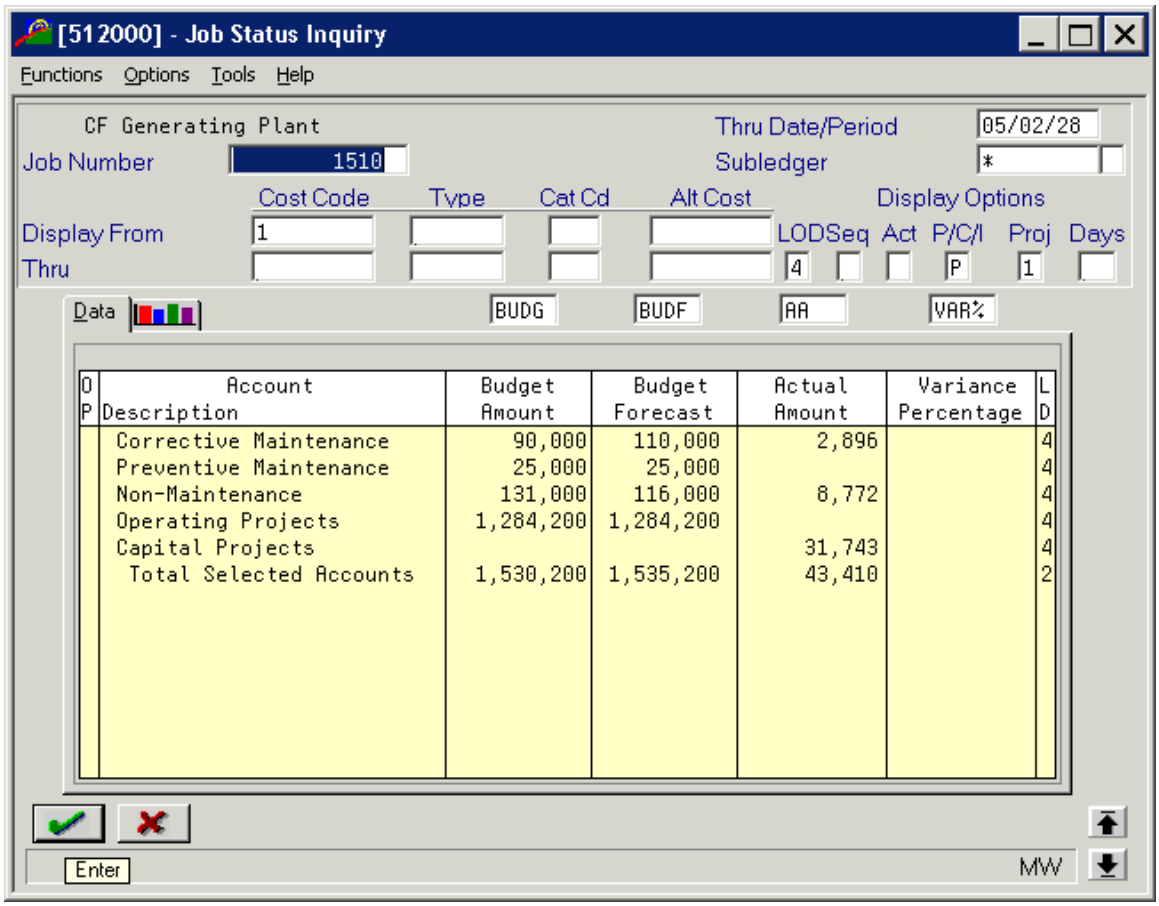
Metric Background:
There are five (5) basic work plan types i.e. corrective, preventive, non-maintenance, operating and capital projects. Each one of these work plan types has a budget set up under their respective business units. Some of these work plan types have program budgets i.e. corrective while others like operating and capital projects have individual budgets. The intent of this metric is to measure compliance with budgets.

Metric Definition:
The information for this metric will be obtained live by the Project Manager or Asset/ Business Unit Manager using the **Job Status Inquiry Screen (512000) in** JDEdwards.

Supporting Information:

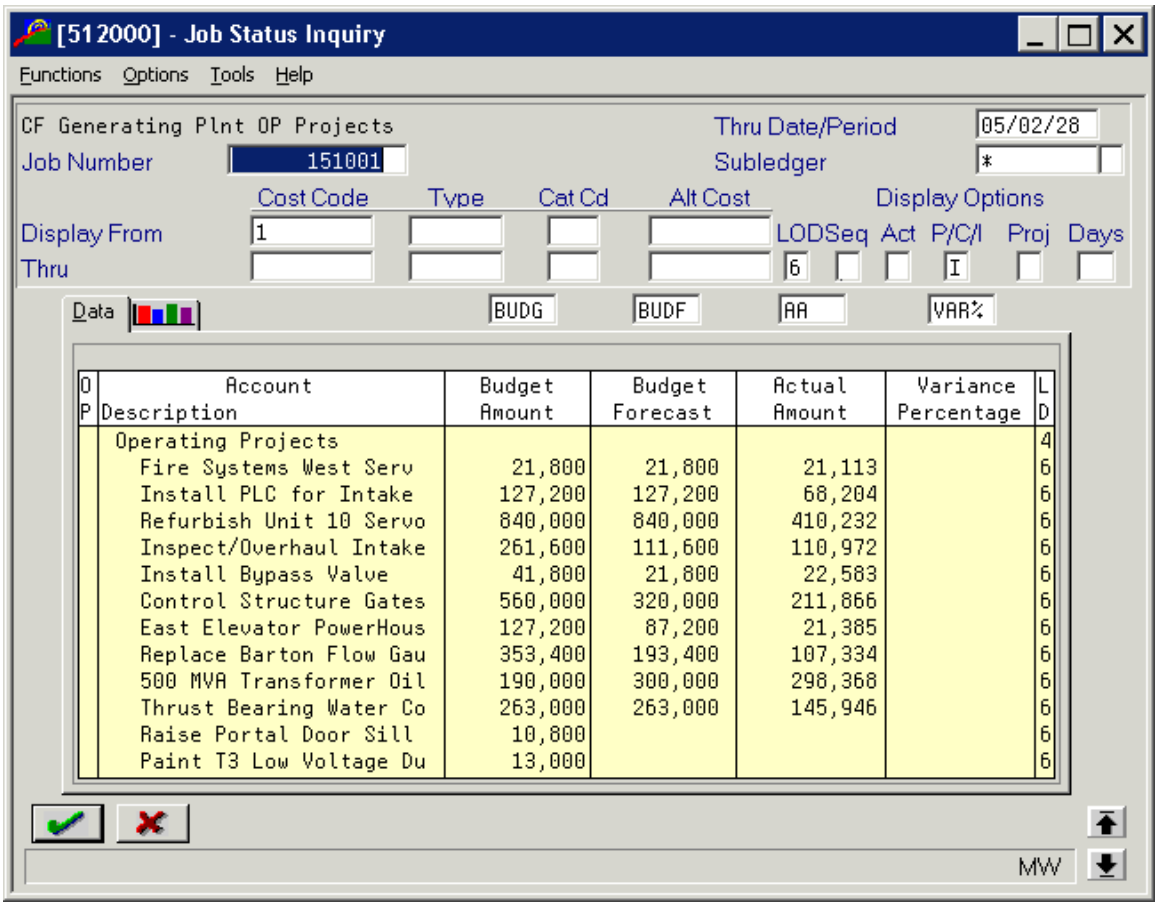


Newfoundland & Labrador Hydro Group of Companies



OP	Account Description	Budget Amount	Budget Forecast	Actual Amount	Variance Percentage	LD
	Corrective Maintenance	90,000	110,000	2,896		4
	Preventive Maintenance	25,000	25,000			4
	Non-Maintenance	131,000	116,000	8,772		4
	Operating Projects	1,284,200	1,284,200			4
	Capital Projects			31,743		4
	Total Selected Accounts	1,530,200	1,535,200	43,410		2

Newfoundland & Labrador Hydro
Group of Companies



OP	Account Description	Budget Amount	Budget Forecast	Actual Amount	Variance Percentage	LD
	Operating Projects					4
	Fire Systems West Serv	21,800	21,800	21,113		6
	Install PLC for Intake	127,200	127,200	68,204		6
	Refurbish Unit 10 Servo	840,000	840,000	410,232		6
	Inspect/Overhaul Intake	261,600	111,600	110,972		6
	Install Bypass Valve	41,800	21,800	22,583		6
	Control Structure Gates	560,000	320,000	211,866		6
	East Elevator PowerHous	127,200	87,200	21,385		6
	Replace Barton Flow Gau	353,400	193,400	107,334		6
	500 MVA Transformer Oil	190,000	300,000	298,368		6
	Thrust Bearing Water Co	263,000	263,000	145,946		6
	Raise Portal Door Sill	10,800				6
	Paint T3 Low Voltage Du	13,000				6

MW

Frequency of Generation:

Operating Projects	**Generate and document at end of each individual project** but recommend generating as often as necessary to manage budget during construction.
Capital Projects:	**Generate and document at end of each individual project** but recommend generating as often as necessary to manage budget during construction.
Non- Maintenance	**Generate at year-end** but recommend generating as often as required to manage budget during year. (Monthly, quarterly, etc.)

Corrective Maintenance	**Generate at year end** but recommend generating as often as required to manage budget during year. (Monthly, quarterly, etc.)
Preventive Maintenance	**Generate at year-end** but recommend generating as often as required to manage budget during year. (Monthly, quarterly, etc.)
Generated by:	Project Manager for Capital and Operating Projects. Asset/Business Unit Manager for Corrective, Preventive and Non Maintenance Budgets.
Target:	To be established by Division/Plant as part of goals and objectives.

Percentage Replanned Work Orders

Introduction

This document is intended to provide a functional specification for measuring replanned work. The primary purpose of this metric is to provide a means, with little effort, to measure replanned work orders by extracting the information from JD Edwards.

Data Sources

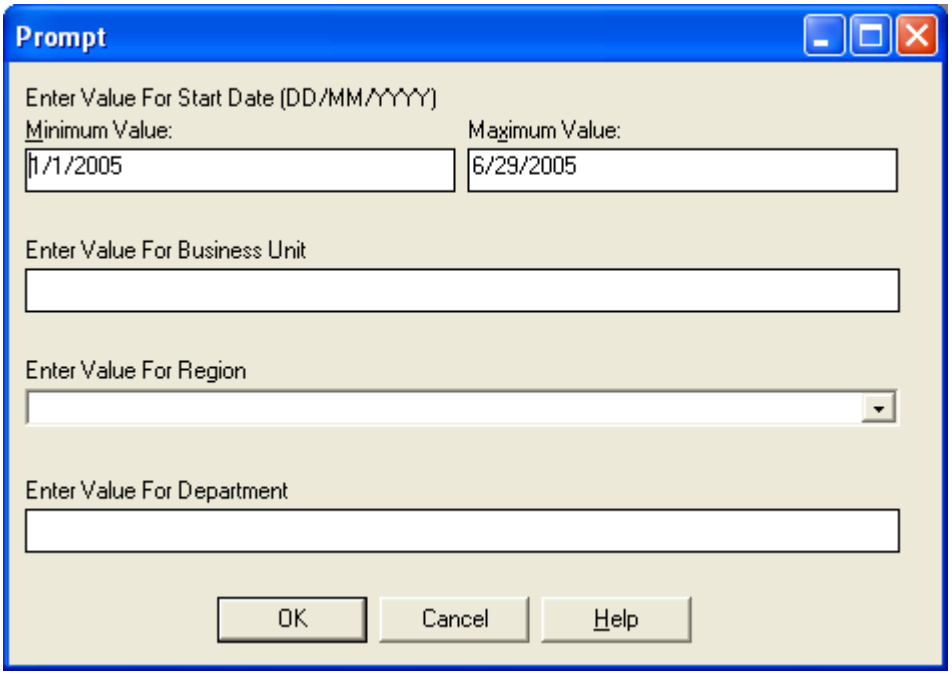
This report returns data from the following table(s) and Column(s) contained in JD Edwards

- **F4801**
  - Work Order Number
  - Business Unit
  - Start Date
  - Description
  - Planning Center
  - Department (Supervisor)
  - Status Code (Work Order)
  - Phase Code (REP)

Query Properties

A predefine “REP” for Reschedules Work is embedded in the conditions of the report

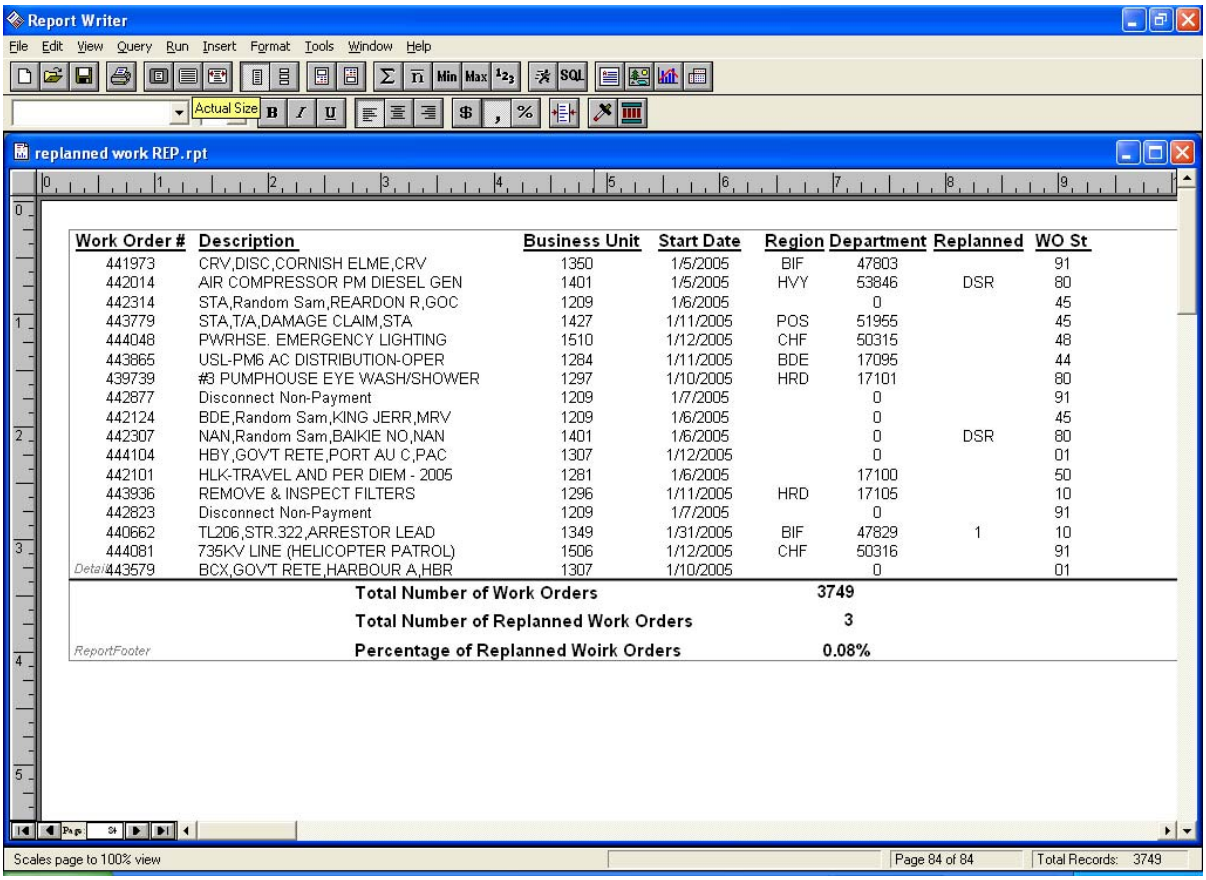
Report Execution



1. Enter a valid Start Date (the last date will remain until changed)
2. Enter A Valid Business unit
3. Enter valid Region (you can select the pull down)
4. Enter a valid Department Number

Select RUN to Execute

Newfoundland & Labrador Hydro Group of Companies



Work Order #	Description	Business Unit	Start Date	Region	Department	Replanned	WO St
441973	CRV,DISC,CORNISH ELME,CRV	1350	1/5/2005	BIF	47803		91
442014	AIR COMPRESSOR PM DIESEL GEN	1401	1/5/2005	HVY	53846	DSR	80
442314	STA,Random Sam,REARDON R,GOC	1209	1/6/2005		0		45
443779	STA,T/A,DAMAGE CLAIM,STA	1427	1/11/2005	POS	51955		45
444048	PWRHSE. EMERGENCY LIGHTING	1510	1/12/2005	CHF	50315		48
443865	USL-PM6 AC DISTRIBUTION-OPER	1284	1/11/2005	BDE	17095		44
439739	#3 PUMPHOUSE EYE WASH/SHOWER	1297	1/10/2005	HRD	17101		80
442877	Disconnect Non-Payment	1209	1/7/2005		0		91
442124	BDE,Random Sam,KING JERR,MRV	1209	1/6/2005		0		45
442307	NAN,Random Sam,BAIKIE NO,NAN	1401	1/6/2005		0	DSR	80
444104	HBY,GOVT RETE,PORT AU C,PAC	1307	1/12/2005		0		01
442101	HLK-TRAVEL AND PER DIEM - 2005	1281	1/6/2005		17100		50
443936	REMOVE & INSPECT FILTERS	1296	1/11/2005	HRD	17105		10
442823	Disconnect Non-Payment	1209	1/7/2005		0		91
440662	TL206,STR.322,ARRESTOR LEAD	1349	1/31/2005	BIF	47829	1	10
444081	735KV LINE (HELICOPTER PATROL)	1506	1/12/2005	CHF	50316		91
Detail 443579	BCX,GOVT RETE,HARBOUR A,HBR	1307	1/10/2005		0		01

ReportFooter		
	Total Number of Work Orders	3749
	Total Number of Replanned Work Orders	3
	Percentage of Replanned Woirk Orders	0.08%

Percentage Rescheduled Work Orders

Introduction

This document is intended to provide a functional specification for measuring rescheduled work. The primary purpose of this metric is to provide a means, with little effort, to measure rescheduled work orders by extracting the information from JD Edwards.

Data Sources

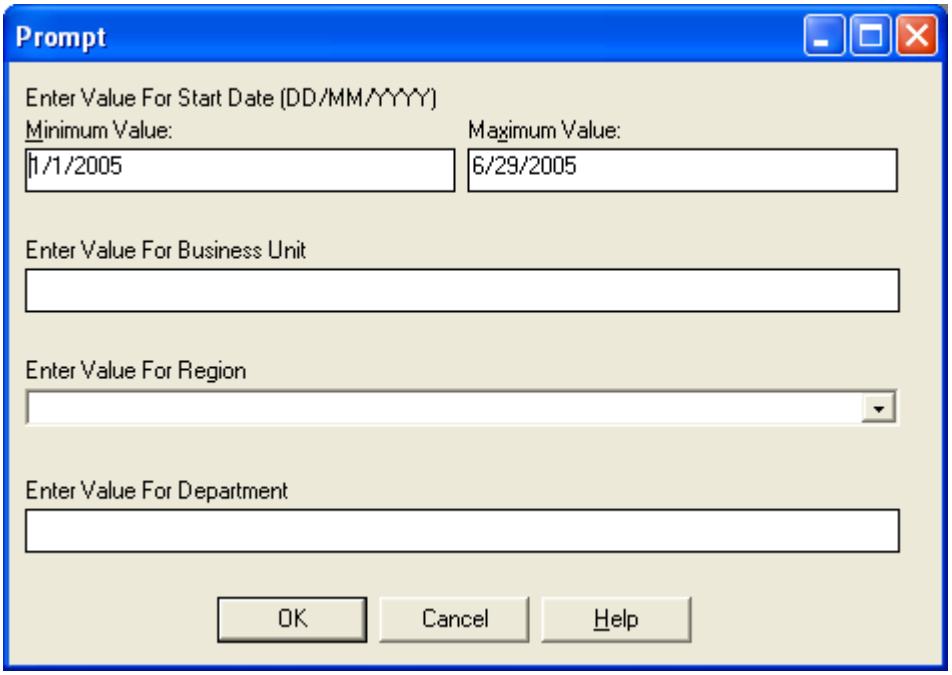
This report returns data from the following table(s) and Column(s) contained in JD Edwards

- **F4801**
  - Work Order Number
  - Business Unit
  - Start Date
  - Description
  - Planning Center
  - Department (Supervisor)
  - Status Code (Work Order)
  - Phase Code (RES)

Query Properties

A predefine “RES” for Rescheduled Work is embedded in the conditions of the report

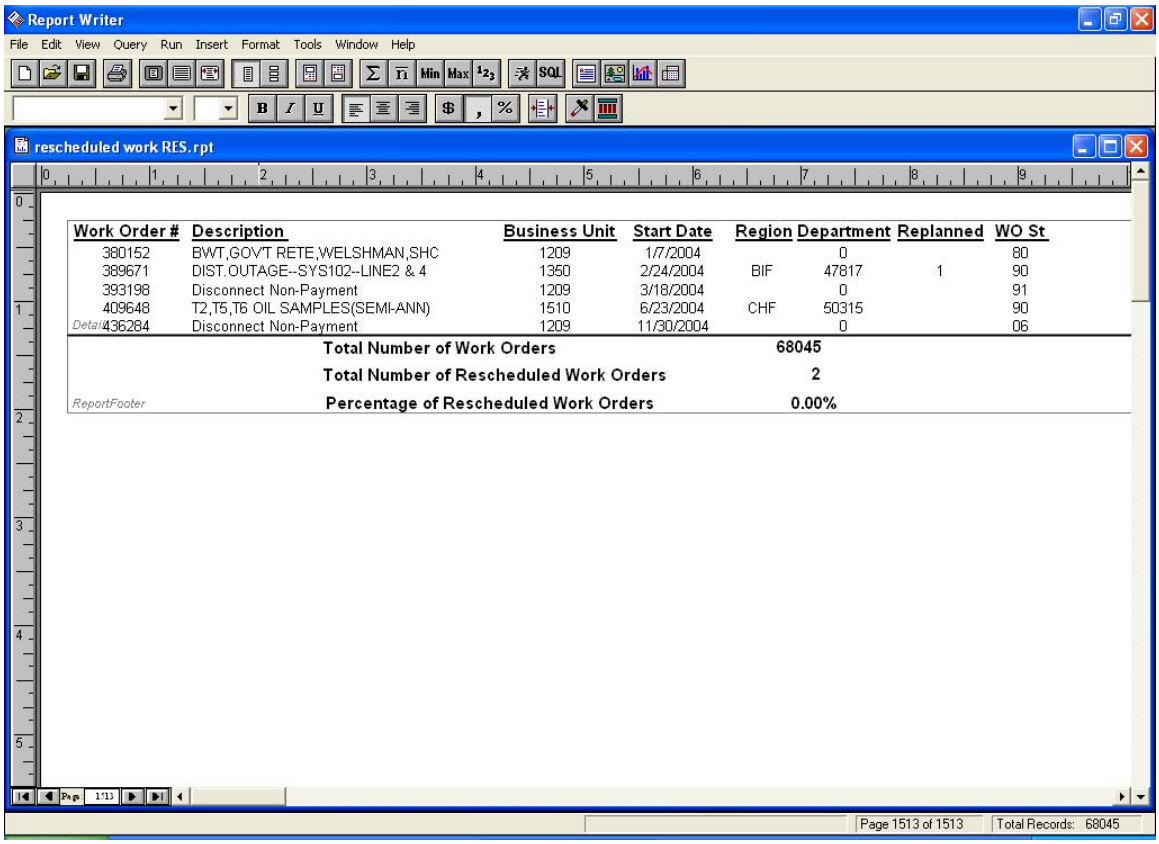
Report Execution



1. Enter a valid Start Date (the last date will remain until changed)
2. Enter A Valid Business unit
3. Enter valid Region (you can select the pull down)
4. Enter a valid Department Number

Select RUN to Execute

Newfoundland & Labrador Hydro Group of Companies



Work Order #	Description	Business Unit	Start Date	Region	Department	Replanned	WO St
380152	BWT,GOVT RETE,WELSHMAN,SHC	1209	1/7/2004		0		80
389671	DIST.OUTAGE--SYS102--LINE2 & 4	1350	2/24/2004	BIF	47817	1	90
393198	Disconnect Non-Payment	1209	3/18/2004		0		91
409648	T2,T5,T6 OIL SAMPLES(SEMI-ANN)	1510	6/23/2004	CHF	50315		90
Detail 436284	Disconnect Non-Payment	1209	11/30/2004		0		06

ReportFooter		
	Total Number of Work Orders	68045
	Total Number of Rescheduled Work Orders	2
	Percentage of Rescheduled Work Orders	0.00%

WRENCH TIME

Background

Wrench time is the primary measure of work force efficiency and of planning and scheduling effectiveness. Wrench time is the proportion of available to work time during which craft technicians are not being kept from productively working on a job site by delays such as waiting for assignment, clearance, parts, tools, instructions, travel, coordination with other crafts, etc. Work that is planned before assignment reduces unnecessary delays during jobs and work that is scheduled reduces delays between jobs.

Definition

This will be done in a non-scientific fashion by all levels of management every two years.

Newfoundland & Labrador Hydro Group of Companies

Metrics for Process

Metric	Generation Frequency	Generation Responsibility	Hydro Group Target	Industry Average
Percentage Weekly Schedule Compliance	Weekly – this may be a manual effort to start	Manager (Business Unit/ Labour) and Frontline	To be determined by Division/Plant	80%
Percentage Work Order Compliance to Estimates (Within +/- 15%)	Quarterly and year-end.	Planning Superintendent/ Supervisor or designate	Division/ Plant target to be determined and set as part of goals & objectives	65%
Percentage Emergency Person Hours Worked	Reportable quarterly with a lag of at least two weeks and at year-end.	Planning Superintendent/ Supervisor or designate	Division/ Plant target to be determined and set as part of goals & objectives	10% or less
Percentage Planned Person Hours Worked	Reportable quarterly with a lag of at least two weeks and at year end	Planning Superintendent/ Supervisor or designate	Division/ Plant target to be determined and set as part of goals & objectives	90%
Percentage Preventative Maintenance Coverage	Report on demand and annually	Planning Superintendent/ Supervisor or designate	Division/ Plant target to be determined and set as part of goals & objectives	30% or greater
Percentage Re-Scheduled Work Orders	Report on demand Recommend Monthly	Planning Superintendent/ Supervisor or designate	Division/ Plant target to be determined and set as part of goals & objectives	N/A
Percentage Re-Planned Work Orders	Report on demand Recommend Monthly	Planning Superintendent/ Supervisor or designate	Division/ Plant target to be determined and set as part of goals & objectives	N/A
Wrench Time	Bi- Annual Internal Survey	Corporate Initiative	-	-

Metrics for Measuring Compliance to Annual Work Plan Types

Metric	Generation Frequency	Generation Responsibility	Hydro Group Target	Industry Average
Percentage Preventive Maintenance Compliance	Quarterly and year-end.	Planning Superintendent/ Supervisor or designate.	To be determined by Division/Plant.	N/A
Percentage Operating Projects Completed	Annually	Planning Superintendent/ Supervisor or designate.	To be determined by Division/Plant.	N/A
Percentage Capital Projects Completed	Annually	Planning Superintendent/ Supervisor or designate.	To be determined by Division/Plant.	N/A
Percentage Non-Maintenance Work Orders Completed	Annually	Planning Superintendent/ Supervisor or designate.	To be determined by Division/Plant.	N/A
Compliance to Corrective Maintenance Budget	Annually (year-end)	Asset/BU Manager	To be determined by Division/Plant.	N/A
Compliance to Preventive Maintenance Budget	Annually (year-end)	Asset/BU Manager	To be determined by Division/Plant.	N/A
Compliance to Non-Maintenance Budget	Annually (year-end)	Asset/BU Manager	To be determined by Division/Plant.	N/A
Compliance to Operating Project Budget	After project completion.	Project/Asset Manager	To be determined by Division/Plant.	N/A
Compliance to Capital Project Budget	After project completion.	Project/Asset Manger	To be determined by Division/Plant.	N/A

Note: Any of those metrics can be generated on demand but as a minimum must be done as per frequency provided above.

Newfoundland & Labrador Hydro
Group of Companies

Weekly Schedule Generator

User Guide

February 16, 2005

1.1 Overview

The Weekly Schedule Generator is an MS-Excel application that allows interactive scheduling of planned work orders on a weekly or even daily basis. The fundamental function of the weekly schedule generator application is to provide a means to schedule work for every available craft hour. The assumption is that planned work orders will have advanced through the work order statuses in JDE to what is referred to as the planned backlog statuses. At this stage of the work order life cycle labour estimates have been applied, materials and/or services are available and the work is ready for scheduling. The weekly schedule Generator extracts applicable work order information as specified by the user from JD Edwards and allows work order selection to a schedule with an instant comparison craft hour loading to available craft hours.

1.2 Initiating the Application

The Weekly Schedule Generator spreadsheet application is deployed to user 'Y' drives and can be accessed by user Citrix Desktop icon or through Windows Explorer.

The spreadsheet can be viewed and modified with any system that has MS-Excel installed.

If the spreadsheet is to be used to query JDEdwards, it **must** be initiated from one of the following:

- Citrix Desktop Icon (see below)
- Citrix Windows Explorer (**y:\citrixapps\bpi-wsg\WSG.xls**.)
- Thin-Client published desktop
- As an attachment in a Lotus Notes email with Notes client accessed via Citrix
- Desktop or laptop computer with MS-Excel and IBM Client Access drivers (access file **y:\citrixapps\bpi-wsg\WSG.xls)**

Newfoundland & Labrador Hydro
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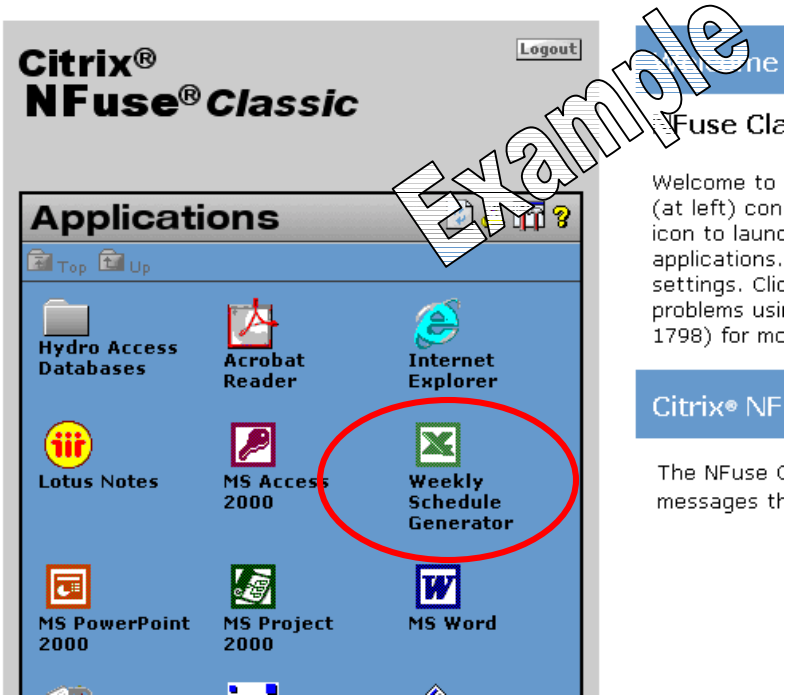
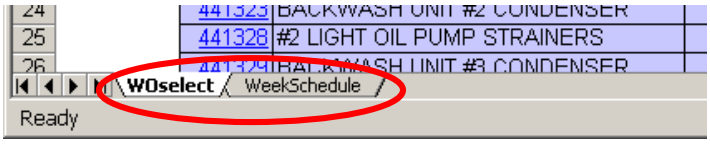


The Excel spreadsheet has two sheets, a **WOselect** sheet for selecting work orders and a **WeekSchedule** sheet for showing or manipulating the schedule. These sheets can be selected at the bottom portion of the worksheet area:



Generating a schedule involves five steps:

1) Query JDEdwards with appropriate criteria to retrieve work orders that have been assigned or created for a particular planning centre.

2) Enter available hours for each craft

3) Select desired work orders to schedule

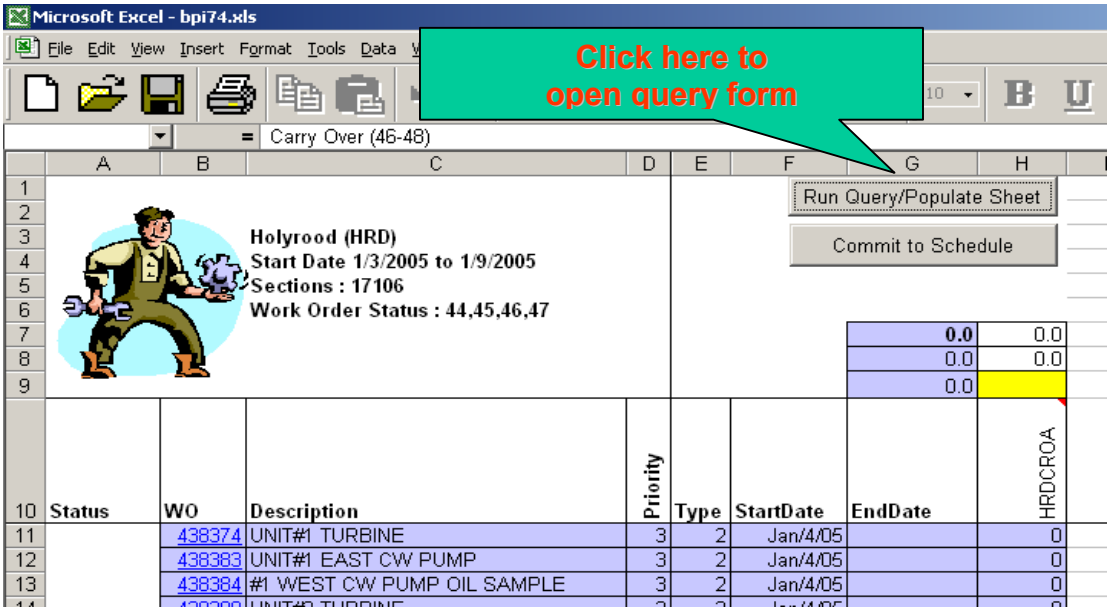
4) Generate a schedule by selecting the desired crafts and number of days to schedule.

5) Print or save the committed schedule

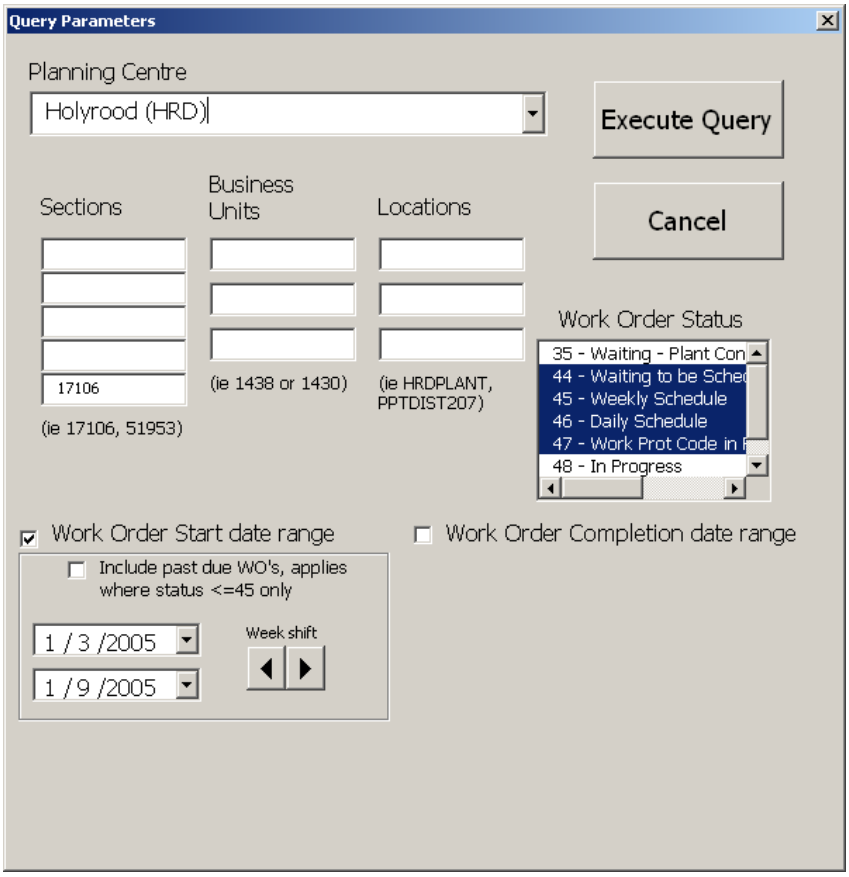
These steps are described in detail in the following sections.

1.3 Query JDEdwards

From the **WOselect** sheet of the Excel spreadsheet, click the 'Run Query/Populate Sheet' button to open the Query Parameters form, which allows entering of query parameters.



From the Query Parameters form it is possible to enter several optional parameters for defining what Work Orders to retrieve from JDEdwards. Any parameters that are defined are saved with the worksheet and are presented as the default values the next time the form is opened.



1.3.1 Planning Centre

A drop down-list of planning centres is available for selection. Only work orders that have the indicated planning center will be retrieved from JDEdwards.

1.3.2 Sections

Up to five Sections may be defined as query parameters. Work Orders that have any of the indicated Sections and meet the other criteria on the form are returned in the query results from JDEdwards. Blank fields are ignored.

1.3.3 Business Units

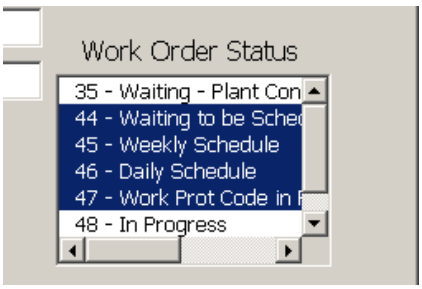
Up to three Business Units may be defined as query parameters. Work Orders that have any of the indicated Business Units and meet the other criteria on the form are returned in the query results from JDEdwards. Blank fields are ignored.

1.3.4 Locations

Up to three Locations may be defined as query parameters. Work Orders created for assets that are in the indicated Locations are returned in the query results (provided the Work Orders comply with the other query parameters). Blank fields are ignored.

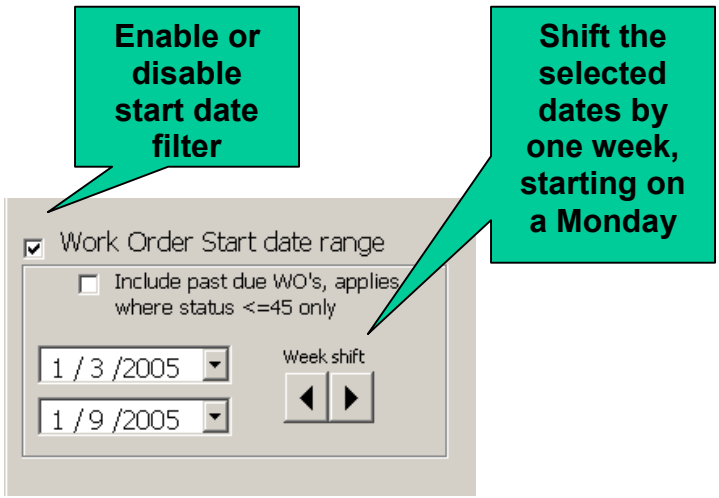
1.3.5 Work Order Status

It is possible to query on one or more specific work order status. Select or de-select the desired work order status' to query for.



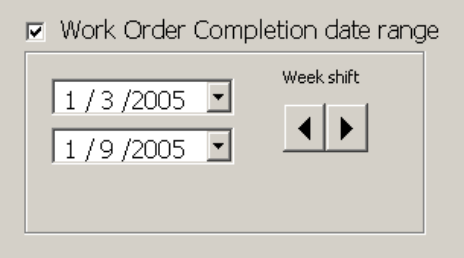
1.3.6 Work Order Start Date Range

It is possible to optionally filter for work orders with a specific start date. A date range can be specified so that only work orders with a work order start date within the range are shown.



1.3.7 Work Order Completion Date Range

Similar to the work order start date filter, it is possible to filter on the completion date for work orders. This filter can be enabled or disabled with the checkbox at the top left.



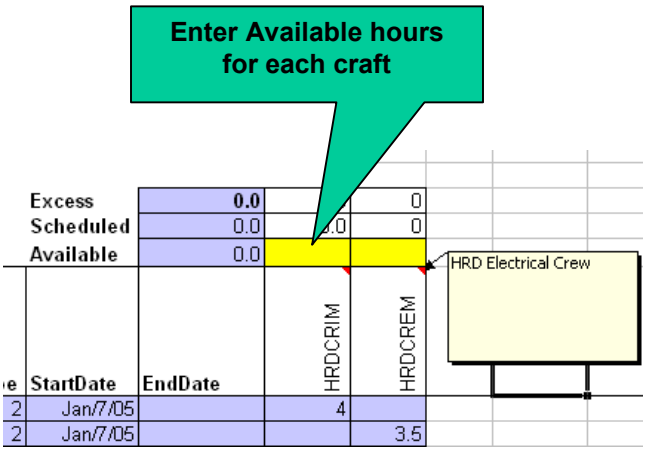
1.3.8 Executing the Query

Press the Execute Query button to run the query against JDEdwards. Depending on the query parameters, the query may take several seconds to complete. A progress indicator at the bottom of the query form indicates the status of the query. When the query is complete, the query form is closed and the results are shown on the **WOselect** sheet.

Note Note that executing the query will overwrite any work orders currently shown on the **WOselect** sheet and any **Available** hours entered for crafts.

1.4 Enter Craft Available Hours For Desired Work Orders

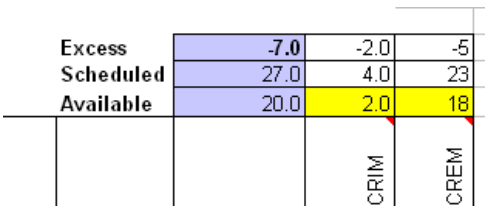
After completing the JDEdwards query, enter the available hours for each craft in the yellow region. As available hours are entered, the tally of total Available hours and Excess hours are recalculated. It is also possible to mouse-over the craft name header columns to get a detailed description of each craft code.



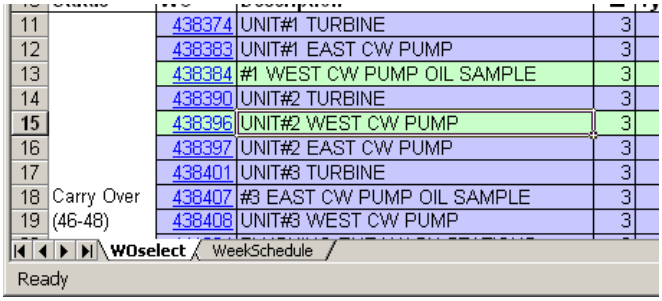
1.5 Select Desired Work Orders

After executing the JDEdwards query it is possible to select and de-select work orders to be transferred to the committed work schedule. At this stage, the objective is to select work orders that maximize the use of available labour. This is achieved by selecting work orders that result in the **Scheduled** and **Available** cells for each craft matching as closely as possible without **Scheduled** exceeding **Available**.

As work orders are selected and de-selected, the totals for **Excess** and **Scheduled** hours are adjusted for each craft.



Selected work orders are shown as Green and non-selected work orders are shown in Blue.

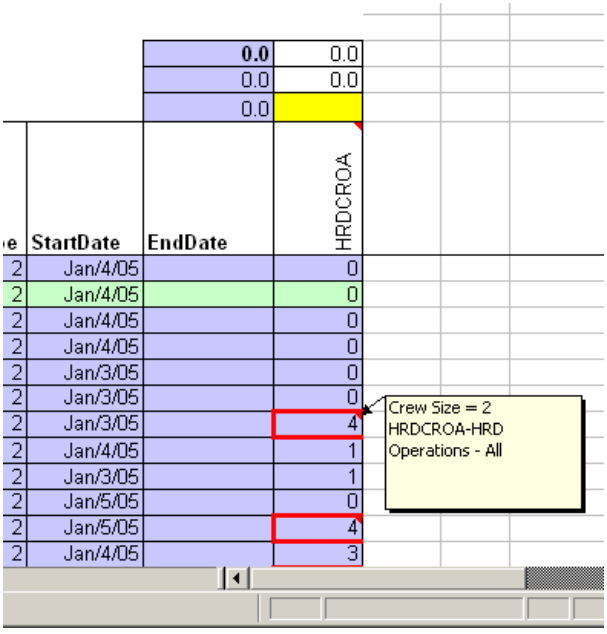


11		438374	UNIT#1 TURBINE	3
12		438383	UNIT#1 EAST CW PUMP	3
13		438384	#1 WEST CW PUMP OIL SAMPLE	3
14		438390	UNIT#2 TURBINE	3
15		438396	UNIT#2 WEST CW PUMP	3
16		438397	UNIT#2 EAST CW PUMP	3
17		438401	UNIT#3 TURBINE	3
18	Carry Over	438407	#3 EAST CW PUMP OIL SAMPLE	3
19	(46-48)	438408	UNIT#3 WEST CW PUMP	3

WOselect | WeekSchedule

Ready

The estimated labour hours from the work order for each craft are shown to the right of the work order completion date column. A cell with a red border indicates that the crew size for the craft is greater than 1. It is possible to mouse-over these type cells and view an Excel comment indicating the crew size and the craft name.

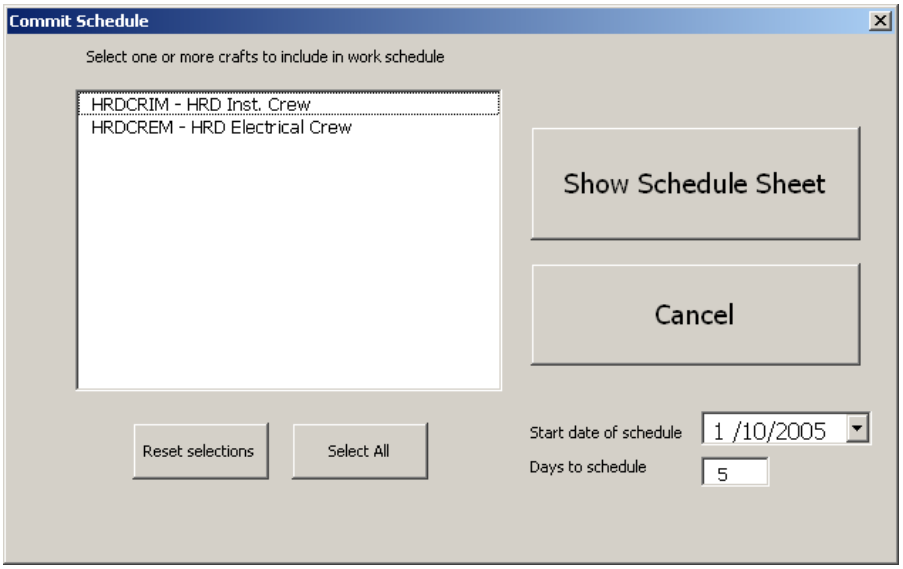


		0.0	0.0	
		0.0	0.0	
		0.0		
e	StartDate	EndDate	HRDCROA	
2	Jan/4/05		0	
2	Jan/4/05		0	
2	Jan/4/05		0	
2	Jan/4/05		0	
2	Jan/3/05		0	
2	Jan/3/05		0	
2	Jan/3/05		4	
2	Jan/4/05		1	
2	Jan/3/05		1	
2	Jan/5/05		0	
2	Jan/5/05		4	
2	Jan/4/05		3	

Crew Size = 2
HRDCROA-HRD
Operations - All

1.6 Generate Work Schedule(s)

Once the desired work orders have been selected and a balance between scheduled and available hours has been achieved, one or more committed schedules can be generated. The committed schedules can be tailored for specific crafts or groups of crafts. Click the **Commit to Schedule** button to present the Commit Schedule form.

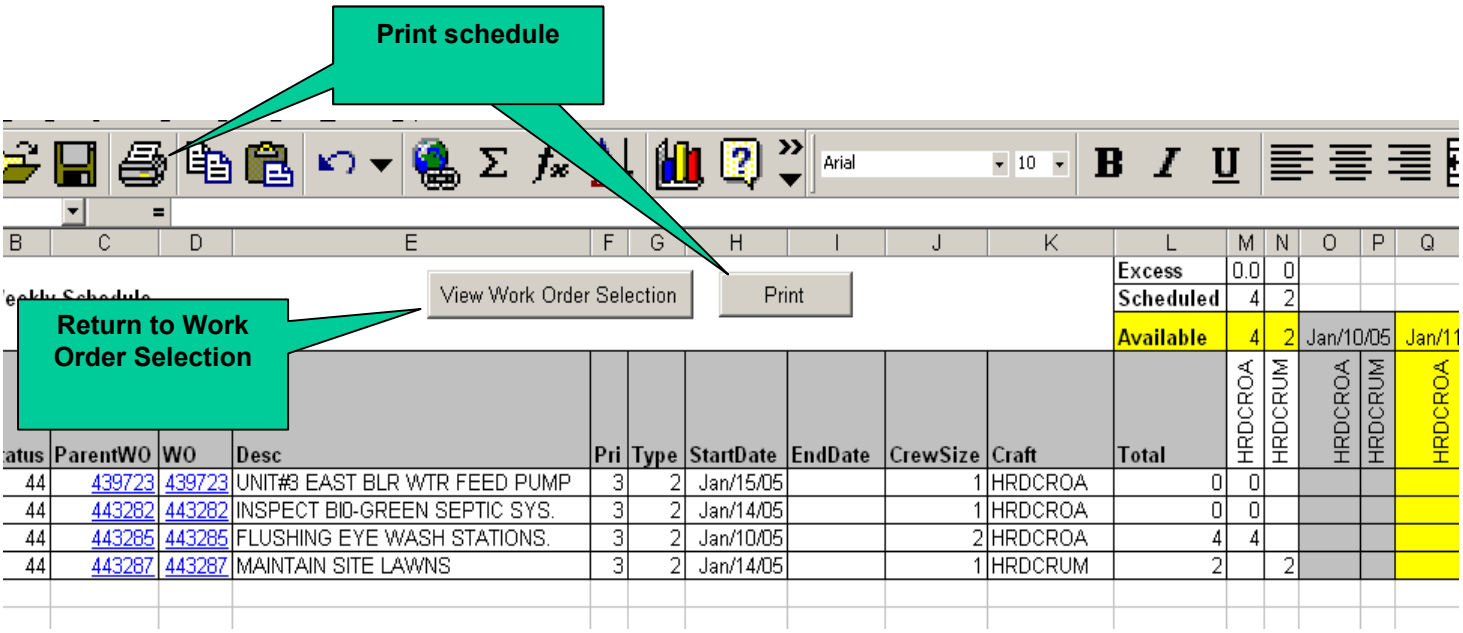


From this form it is possible to select crafts that are to be shown on the committed schedule. Any of the selected work orders that have the selected crafts will be shown. As well, any other crafts on the selected work orders will be shown on the committed schedule. The committed schedule will have the available hours for each craft as they were entered on the **WOselect** sheet.

This form also allows selection of a start date and the number of days to schedule. These days will be shown on the committed schedule, extending to the right edge of the sheet.

1.7 Print or Save the Work Schedule

Once the schedule has been committed, it can be copied, modified or altered like any other Excel spreadsheet. Scheduled and available hours may be altered and any final adjustments to the spreadsheet may be made. The sheet can be printed using the standard MS-Excel print functions or with the Print button in the header portion.



atus	ParentWO	WO	Desc	Pri	Type	StartDate	EndDate	CrewSize	Craft	Total	HRDCROA	HRDCRUM	HRDCROA	HRDCRUM	HRDCROA
44	439723	439723	UNIT#3 EAST BLR WTR FEED PUMP	3	2	Jan/15/05		1	HRDCROA	0	0				
44	443282	443282	INSPECT BIO-GREEN SEPTIC SYS.	3	2	Jan/14/05		1	HRDCROA	0	0				
44	443285	443285	FLUSHING EYE WASH STATIONS.	3	2	Jan/10/05		2	HRDCROA	4	4				
44	443287	443287	MAINTAIN SITE LAWNS	3	2	Jan/14/05		1	HRDCRUM	2		2			

When the worksheet is saved, all information is saved, including the most recent query parameters, the work order selections and the committed schedule.

Appendix

What it won't do…

Keep schedule related information when you refresh the query (i.e. work orders list).

Update work order information in JDE automatically.

Prevent a user form corrupting the spreadsheet by deleting critical elements, formulas, etc.

Keep a work order high-lighted if you go back and edit it (or click on it in any way). If you click on a highlighted work order (in the WO Select screen) for any reason, it becomes un-highlighted and you have to click it again to re-select it.

Won't consider or reflect the high level work schedule and budget/work plans, that has to be manually considered.

Automatically track compliance measures.

What it will do…

Pick up all work orders meeting prompt criteria.

Allow user to select specific work orders for the Weekly Schedule.

Allow user to enter the available person-hours by craft.

Calculate required person-hours by craft based on selected work orders.

Calculate unscheduled hours by craft by subtracting required person-hours from available.

Allow user to modify spreadsheet, typical of any Excel spreadsheet.

Allow user to overwrite text and fields and hour estimates, etc.

Allow user to add text to the spreadsheet.

Allow the user to delete unwanted cells, rows or columns.

Allow the user to download a copy of a controlled version, work with that copy and save it for reference or distribution under a different file name/location.

You can manually overwrite personhour estimates on the WO Select screen and/or add estimates where none exist (side note that if you click onto a selected job to add hours, it will take the hours but become deselected (blue), you have to click it again to select to schedule).

Personhours shown for standing and in progress (46 - 48) work orders are the original estimates with no adjustment for any completed work - as I said you can overwrite them.

Allow users to manually enter job compliance estimates against each work order (using an empty column) and sum the values and calculate average Job Compliance, which can be manually trended. Text notes can also be saved against Job Compliance numbers in another empty column.

Allow the user to save versions and views of the Weekly Schedule with different filenames (convention required to standardize naming).

Allow the user to schedule for more than a week or further into the future than next week. The user can decide which time frame is desired, enter the appropriate available person-hours by craft for that time frame and select appropriate work orders for that time frame.

What is required of user…

Understanding of applicable codes on work orders and how to interpret/use them.

Understanding of basic Excel, including adding text, cut, copy and paste.

Understanding of how the query obtains and filters data.

Understanding of how to get a new copy if they break the one they have.

Understanding of the file naming convention and where and how to save copies for history.

Things to watch…

The link to detailed work order information pulls many fields related to the work order, all of which are used somewhere in JDE for different purposes. Some of the estimate and actual data may not be what the user expects and should be viewed with caution.

Newfoundland & Labrador Hydro
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Routine Work Prioritization

Routine Work Prioritization Guide

Work Order Number: _____

Evaluation Factors:

1) **Importance = (a)*(b)*(c)*(d)*(e)*(f)**

(a) The work is: Reject if (a) = 0

Other	Corporate Mission Support	Justifiable	Necessary	Essential
0	1	2	3	5

(b) The loss type is:

None	Facilities / Equip.	Production	Delivery	Safety & Health or Environment
1	2	3	4	5

(c) Equipment Criticality:

Other	Standby Unit in Critical System	Critical to Plant or Station	Critical to Entire System	Critical Safety Protective Device
1	2	3	4	5

(d) Loss can be mitigated by:

Available Redundant Equipment	Available Backup Option	Nothing
1	3	5

(e) Loss probability is:

Low	Medium	High
1	3	5

(f) Loss Potential is:

Minimal	Moderate	Substantial
1	3	5

Total = (a)*(b)*(c)*(d)*(e)*(f)

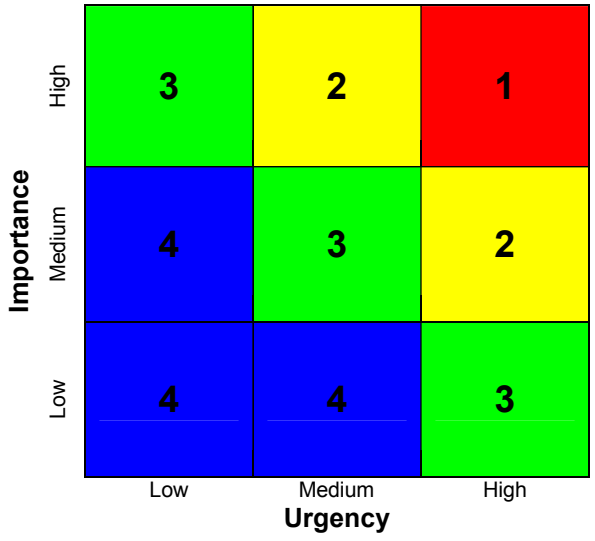
Low	**Medium**	**High**
< = 72	**73 – 1619**	**> 1619**

2) Urgency:

How long can the work be delayed before the above loss is incurred?

Low		**Medium**	**High**
N/A	**> 1 month**	**<= 1 month and > 1 week**	**<= 1 week**

3) Priority Matrix:



Priority Action Timeframe

- Immediately
- 1-7 Days with Target Start
- 8 Days – 4 Weeks with Target Start
- Schedule as Required with Target Start

The above provides a simple, standard methodology for evaluating and prioritizing the majority of day-to-day routine work. It provides a mechanism for combining a few evaluation factors to produce an overall level of importance, which in turn, when combined with urgency, will determine the priority of the planned piece of work. It also provides a record of the evaluation for future benchmarking purposes. It is not meant to replace good judgment or discussion between work planners, but to provide some factors to consider when prioritizing work. This methodology should be applied to all routine day-to-day work. While OP, CP and NM initiatives will be prioritized using the Work Identification & Prioritization project/initiative evaluation methodology, individual work orders cut against them should be prioritized using this methodology. The user of the above sheet would simply pick the appropriate fields and the calculation of the importance and urgency and the resulting priority would be done automatically. If the total for importance exceeds the medium range, before completing all importance factors, it wouldn't be necessary to complete the remainder of the importance factors.

Evaluation Factors:

The following provides some guidelines when assessing the range of each evaluation factor. Both importance and urgency can evolve due to changes in circumstances and these can ultimately impact the priority.

1) Importance

(a) **"The work is?"** This factor covers the work category.

- **Other:** The work is not required and should be rejected if it doesn't fit into the following work categories.
- **Corporate Mission Support:** At a bare minimum, our work should support our corporate mission by aligning to our goals and objectives. For example, enhancing our public image through provisions of materials and labour for municipal celebrations.
- **Justifiable:** This refers to work that will provide a benefit to the company that outweighs its cost. These benefits may be financial or non-financial (E.g. Improved customer service index)
- **Necessary:** This refers to work required to maintain facilities and operations in adequate condition to meet anticipated activity levels. For example, a derated unit at Holyrood may be required at full load within a week because of system load projections. More examples of necessary work would be JD Edwards is down (during normal service hours), the AS400 production machine is down, or the Corporate LAN is down.

- **Essential:** Work that is required to meet government regulations, legal requirements, or minimum environmental/safety standards. For example, work to address a class "A" safety hazard or work covered under the wood pole agreement with Aliant would be considered essential.

(b) **"The loss types"** are as follows:

- **None** if there is no loss associated with not performing the work.

- **Facilities/Equip.** if there is a potential or existing loss of support facilities or equipment not directly related to the production or delivery of electrical energy. For example, line depots, regional offices, Hydro Place, servers, office equipment could be covered under this loss type.

- **Production** if there is a potential or existing loss to equipment or systems related to the production of electrical energy such as hydraulic or thermal generating equipment, dams, control structures, etc. This type focuses on unit unavailability without having major customer delivery implications.

- **Delivery** if there are potential or existing customer outages resulting from equipment or systems involved in the production, transmission or distribution of electrical energy. The focus here is on external customer outages due to generation unavailability, transmission line or distribution feeder outages.

- **Safety & Health or Environment** if the loss has or will have an impact on employee or public safety and health such as rotten wood poles, defective distribution disconnects, line road crossings, etc. or on the environment such as a potential contaminant release.

(c) **"Equipment Criticality"** asks for an indication of how critical the equipment is to the company's operations.

- **Other** is used to capture all equipment/systems that are less critical than those in the following groups.

- **Standby Unit in Critical System** would cover equipment like backup chargers in terminal stations, ring bus breakers in terminal stations, backup 230 kV line protection, parallel lines, etc.

- **Critical to Plant or Station** covers equipment/systems that are critical to a plant's or station's function such as line breakers, power transformers, RTUs, radial lines, etc.

- **Critical to Entire System** covers equipment/systems that are critical to the an entire system's function, whereby system is defined as the main power grid (interconnected island or Labrador) or any isolated diesel system,

- **Critical Safety Protective Device** covers equipment/systems that are in place to provide safety protection in the event of equipment failure such as pressure relief valves, surge tanks, fire alarm/protection systems, etc.

(d) **"Loss can be mitigated by"** covers the kind of mitigation that could offset the impact of the loss.

- **Available Redundant Equipment** covers equipment/system that is a direct replacement for the equipment experiencing the loss. For example, this would include a parallel battery bank charger, a parallel line or transformer, a spare diesel unit, backup line protection, etc.

- **Available Backup Option** covers options that are not direct replacements but provide the same function. These options would usually come at some extra cost. For example, mobile substations/diesel units/ transformers, temporary bypasses, alternate feeds, etc.

- **Nothing** covers the case where there are no options for mitigating the loss.

(e) **"Loss Probability"** provides an indication of how probable the loss event may occur. This will require judgment based on equipment history and present condition and may also be influenced by external factors such as weather forecasts, load projections, system conditions, season, etc.

(f) **"Loss Potential"**: An assessment of the loss extent that could be suffered to people (loss of life, injury, etc.), environment (spills, exposures, hazards, etc.) and/or plant/asset/equipment/systems if the job is not completed soon. This is not a probability assessment but an indication of how much damage could occur. This again will require judgment based on system knowledge and external factors. For example, if delaying a job could result in no injury, low plant/asset/equipment loss and significant environmental loss, then the loss potential would be substantial due to the environmental factor. Another example could be a computer virus, which affects a few people but has the potential to affect every user. This case would have a substantial loss potential. The loss potential extent should also be evaluated in terms of its cost. For example, minimal loss potential could be a cost of less than $1,000. Moderate loss potential could be a cost of $1,000 to $10,000 and substantial could be greater

than $10,000. These limits would have to be agreed upon before implementing this methodology. Another consideration is the loss's impact on the system. For example, if the loss is limited to local systems such as a local server, security system, air conditioning unit, vehicle, etc. or parts of systems such as a distribution feeder, a terminal station, a generating unit in a multi-generator plant, etc., then it may be considered a moderate loss. However, if the loss affects or will affect an entire system such as the Island grid, an isolated diesel system, an interconnected distribution system, the ECC control system, all PC users on the corporate network (E.g. Software virus), etc., then that should be considered a substantial loss. Staff productivity needs to be considered here in the case of losses associated with facilities or equipment like servers, buildings, printers, etc. The loss potential could range from one person (i.e. minimal) to all users (i.e. substantial).

2) Urgency

This factor takes into account the timing requirements of the work. This is again a judgment call that takes into account risks. One needs to consider the above loss potential(s), along with its probability, to determine how long the work can be delayed before incurring the loss(es). Influencing factors could be weather or season, unit outage coordination, load projections, coordination with other higher priority work, or work type (E.g. Preventive maintenance, Corrective Maintenance, etc.). For example, an impending lightning or sleet storm may necessitate that work be carried out within the next 2 days or a planned unit outage may be coordinated with previously unidentified work to take advantage of the outage. In any case, the urgency chosen needs to be justified based on some risk assessment. The user will indicate N/A (i.e. not applicable) for work that doesn't have any losses associated with it.

3) Priority Action Time Frames

The following timeframes are merely guidelines for planners when scheduling work. They may be impacted by resource (human and goods & services) availability. The main emphasis is that **higher priority work should get completed before lower priority work**.

Priority 1 = Immediately (An injury has occurred or may occur; customer outage is ongoing or pending; necessary production is stopped or about to be stopped; or significant damage to plant/asset/equipment or environment has occurred or may occur. This is urgent reactive work of high importance, with no planning or scheduling within JDE).

Priority 2 = 1 Day - 7 Days with target start date (Work must be started as promptly as possible with some planning done prior to it's commencement, as time permits. This is reactive work with some planning and scheduling within

JDE.) This work is of an either high urgency and medium importance nature; or medium urgency and high importance nature.

Priority 3 = 8 Days - 4 Weeks with target start date (This is important proactive work that is not urgent and must be fully planned and scheduled within JDE.) This work is of an either high urgency and low importance nature; medium urgency and medium importance nature; or low urgency and high importance nature.

Priority 4 = Schedule as required with target start date (Any work that is required to be done but is not, at this time, affecting safety, health, environment, production or cost. It may be upgraded to another priority should the work become more urgent due to deteriorating or changing conditions. This is required proactive work of low to medium importance and low urgency or low to medium urgency and low importance that must be fully planned and scheduled within JDE).

Newfoundland & Labrador Hydro
Group of Companies

JOB PLAN REPOSITORY

Background

In the past, maintenance planners have used various methods of keeping job records to use for future job planning and in some instances job plans have not been saved. The result is bits and pieces of information stored in a many locations, and in worst cases, repetitive jobs have been planned more than once. These job plans reduce the need to do site visits, reduce the time required to prepare a job for release, and improve accuracy of estimates of labor and material requirements. These plans were not usually revised to include any lessons learned.

Step 3 Planning, box 13 Extensive Planning in the work execution flowchart for routine work identifies the requirement to utilize existing job plans. The expectation is to store job plans for future planning in an effort to reduce the amount of time spent by planners preparing jobs that have been done before and will likely be done again. Today, these plans are being filed in different ways by different planning centers. What is required is a Job Plan Repository. A common bank of stored job plans that can be accessed by planners, known as a Job Plan Repository, will be extremely beneficial to the planning department. Job plan data may be extracted from work methods, job procedures, engineering directives and other sources.

Purpose

The primary purpose of the Job Plan Repository is to provide planners with a data bank of job plans to draw upon so that every job does not have to be planned from scratch. The planner must do research to create job plans. It is not only the key lessons learned over the past years but also and more importantly the thousands of minute details of particular jobs on particular equipment that can make the difference between a 2-hour job and a 5-hour job. It is the ability to capture this information and apply it to future work precisely when needed that makes the job plan repository valuable to the planner and hence to the company.

Newfoundland & Labrador Hydro
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Prioritization Calculator

Background

Consistent application of priorities for routine work orders has always been an issue throughout the Hydro Group. A guide has been developed to assist in determining proper priorities. The guide provides a mechanism for combining several evaluation factors to produce an overall level of importance, which in turn, when combined with urgency will determine the priority of the work. This guide is not intended to replace good judgment and there may be cases where the guide is not well suited.

Purpose

The purpose of the Prioritization Calculator is to allow the user of the Prioritization Guide to simply select the importance factors and urgency rating and the resulting priority will be automatically calculated. The Prioritization Calculator eliminates the manual calculation process.

Newfoundland & Labrador Hydro Group of Companies

Routine Work Prioritization Guide

Work Order Number: _____

Evaluation Factors:

1) **Importance = (a)*(b)*(c)*(d)*(e)*(f)**

(a) The work is: Reject if (a) = 0

Other	Corporate Mission Support	Justifiable	Necessary	Essential
0	1	2	3	5

(b) The loss type is:

None	Facilities / Equip.	Production	Delivery	Safety & Health or Environment
1	2	3	4	5

(c) Equipment Criticality:

Other	Standby Unit in Critical System	Critical to Plant or Station	Critical to Entire System	Critical Safety Protective Device
1	2	3	4	5

(d) Loss can be mitigated by:

Available Redundant Equipment	Available Backup Option	Nothing
1	3	5

(e) Loss probability is:

Low	Medium	High
1	3	5

(f) Loss Potential is:

Minimal	Moderate	Substantial
1	3	5

Total = **(a)*(b)*(c)*(d)*(e)*(f)**

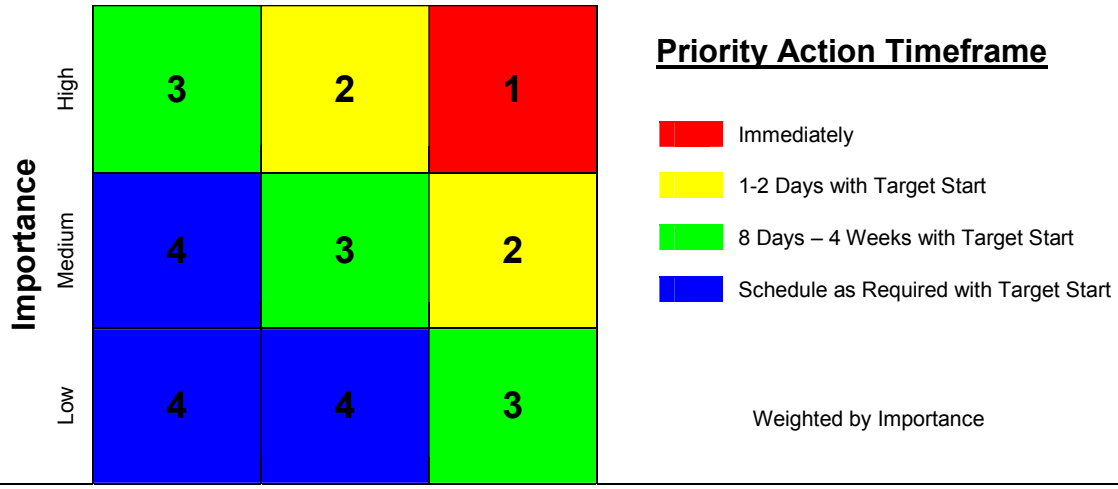
Low	Medium	High
< = 72	73 – 1619	> 1619

2) Urgency:

How long can the work be delayed before the above loss is incurred?

Low		Medium	High
N/A	> 1 month	<= 1 month and > 1 week	<= 1 week

3) Priority Matrix:



Outage Database

This tool as been passed to another PIT team for development.

Background

The outage Management subprocess was originally identified as a function of the Work Execution process. As a result of progress on the Work Execution process, and development in the Work Identification and Prioritization and Work Budgets process, it became apparent that there is an opportunity to further streamline and harmonize activities related to asset outages. It also became apparent that there is an opportunity to more fully define the roles and responsibilities of various positions in the organization as it relates to managing asset outages from preliminary concept through to eventual completion. Accordingly, the Outage Management subprocess was extracted from the above three processes for further work, leading to the current proposal.

As the Outage Management subprocess is in fact a component of the three processes, the relationship with the overall Corporate Strategic Plan is derived accordingly. More specifically, the Outage Management subprocess contributes to the overall goal of optimizing corporate performance by supporting these processes. Understandably, much of the Outage Management charter grounds its content in those of the Work Identification and Prioritization, Work Budgets, and Work Execution Process, with particular emphasis on the latter.

Purpose

When the Outage Management subprocess has been improved, equipment outages will be more effectively utilized across functional and departmental lines, leading to an increase in equipment availability, a reduction in repeat equipment maintenance outages, and the establishment of clear roles and responsibilities in the outage requesting-approval process from project identification through to work completion. By implementing the Outage Management subprocess, the organization will be better able to leverage the expected improvements associated with Work Identification, Work Budgets and Work Execution initiatives.

GLOSSARY OF TERMS

Assumptions: Factors that, for planning purposes, are considered to be true, real or certain. Assumptions affect all aspects of project planning, and are part of the progressive elaboration of the project. Project teams frequently identify, document and validate assumptions as part of their planning process. For example, if the date that a key person will become available is uncertain, the team may assume a specific start date. Assumptions generally involve a degree of risk.

Backlog (Planned): Work orders planned and prioritized, waiting scheduling and execution.

Benchmarking: A continuous improvement process of examining companies that are more effective in a specific process learning how they became more effective and then adapting their methods to your company's process with a goal of improving your process.

Capacity:

Communication: A process by which information is exchanged between individuals through a common system.

Compliance: Adherence to a defined process (i.e. schedule).

Computerized Maintenance Management System: A computer program that manages the performance of maintenance through work orders. (i.e. J.D. Edwards)

Constraints: A constraint is an applicable restriction that will affect the performance of the project. For example, a predefined budget is a constraint that is highly likely to limit the team's options regarding scope, staffing and schedule. When a project is performed under contract, contractual provisions will generally be constraints.

Continuous Improvement: The process of constantly making a company's business processes better.

Execution: The act of actually doing the work.

Feedback: Information provided by assigned worker or supervisor on a job plan package that will enhance future packages.

Inventory: Spare parts or equipment components kept in case of an equipment breakdown or for replacement when the original part or equipment component wears out.

Load: Work submitted to a schedule, against known resource available, until schedule is filled to a percentage. (i.e. 100 hrs available---100 hrs submitted = 100% loaded)

Maintenance (Corrective): Any maintenance activity required to return assets to desired operating characteristics. Activities required correcting a failure that has occurred or is in the process of occurring. Usually the result of unexpected breakdown, emergencies, or items detected during inspections. May consist of repair, restoration or replacement of components.

Maintenance (Preventive): Planned and proactive maintenance activities (inspect, test, lubricate, clean, replace regular components etc) carried out on assets at pre-determined levels. The frequency established may be based on calendar time, or other occurrences such as starts, stops, odometer readings, number of operations, running hours etc.

Maintenance (Predictive): Maintenance activities (inspections, condition based monitoring) used to predict if and when future asset failures will occur. The prediction is based on trend analysis of diagnostic data collected by techniques such as vibration analysis; lube oil analysis, infrared testing, equipment history analysis etc. Predictions can also be experience based. (Visual inspection of wooden poles)

Maintenance: Any activity carried out to retain an item in, or restore it to, an acceptable condition for use or to meet its functional standard.

Metrics: Measures for checking how the process is functioning.

Performance Indicators: Descriptive signals that some action needs to be taken.

Performance Measurement: The act of measuring performance.

Planner: Any person who does planning on a piece of work. (i.e. assigns materials, assigns labour, does engineering, etc.)

Planning (Extensive): The degree of planning applied to large, critical and more complex pieces of work. Includes verifying/defining scope of job, providing labour estimate, identifying/specifying/procuring parts, and other requirements such as identifying/arranging special tools, arranging outages, developing drawings,

considering safety/environmental standards, coordinating with other departments, arranging transportation/accommodations, considering customer impact/coordination and any other detail required to complete the job.

Planning (Minimal): The degree of planning applied to smaller jobs of which it is not cost effective to spend much planning time on. Those jobs are normally short duration, single craft, low dollar value, of very little historical value and while parts may be required, the parts are normally low dollar value and readily available in stores or in consumable bins. Sufficient planning for this type of work should include clear description of work, labour estimate by craft and parts list if required.

Planning: A major strategy to improve maintenance efficiency with regard to unproductive time. Its provides crews with job scopes, labour estimates by craft, material requirements, and other information required to get the job done efficiently and effectively such as special tools, drawings, special procedures when available, outage arrangements, special permits etc.

Priority: The relative importance of a single job in relationship to other jobs. Safety, production, environment are major considerations in establishing priorities.

Procurement: A function within the organization that is responsible for obtaining and storing spare parts, equipment or raw materials required to support the maintenance function.

Project Deliverables: A list of the summary level sub products whose full and satisfactory delivery marks completion of the project. For example, the major deliverables for a software development project might include the working computer code, a user manual and a tutorial. When known, exclusions should be identified.

Project Objectives: The quantifiable criteria that must be met for the project to be considered successful. Project Objectives must include at least cost, schedule and quality measures.

Project Plan: The project plan is a formal, approved document used to manage project execution.

Reliability: The probability that equipment or an asset will perform its designed function without a failure for a period of time under specific conditions.

Resource Capacity Planning: Planning and scheduling work for a known number of resources (i.e. tools, manpower, etc.) Checking for over or under allocation of resources and levelling where possible.

Scheduling: Scheduling is primarily arranging planned work orders in the sequence in which they are intended to be done. It is also designating work to be done at a specific time. Good scheduling reduces lost time between jobs.

Scope: The extent and detail of the work to be done.

Stakeholder: Any person, organization, etc. directly impacted by the process.

Supervisor: A front line manager usually responsible for a group of employees executing work.

Target: The goal intended to be attained (and which is believed to be attainable).

Work (Capital): The acquisition, improvement or disposal of fixed or leased assets. Includes the cost of pre-engineering, feasibility, environmental or other studies.

Work (Non Maintenance): Work not directly associated with an asset. Example: Corporate Programs.

Work (Proactive): Work that is anticipated and planned for.

Work (Project): Work that is not addressed within the organizations normal operational limits. It has a definite beginning and definite end and is normally performed on assets on a one time or infrequent basis. It is usually unique in nature.

Work (Reactive): Work that occurs with little or no notice. This work interrupt schedules and cost much more than planned and scheduled work. Work that is performed as a response to a failure, breakdown or other urgent equipment situation.

Work (Routine): Routine work is ongoing and to some degree repetitive and is normally done to sustain the business. Routine work consists of corrective; preventive, non-maintenance and small capital such as service extensions and emergency upgrade work.

Work Package ????

Work Plan ????

Work Status ????? i.e. 48, 30 etc.

Work Breakdown Structure (WBS): A WBS is a deliverable-oriented grouping of project components that organizes and defines the total scope of the project; it is often used to develop or confirm a common understanding of project scope. Each descending level represents an increasingly detailed description of project deliverables.

Work Order: A document used to request, plan, schedule, track and report on all work activities.

Work Request: Formal request to have work performed. Subsequently transformed into a Work Order upon authorization.

Wrench Time: This is the proportion of available-to-work time during which craft technicians are not being kept from productively working on a job site by delays such as waiting for assignment, clearance, parts, tools, instructions, travel, coordination with other crafts or equipment information.

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POST IMPLEMENTATION REVIEW REPORT

Project Name:

Project Number:

Project Date:

Project Classification: ☐ **Operating** ☐ **Capital**

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1. Introduction

Project Information

Name of Project:

Project Owner:

Type of Project: *Application Development; Commercial Off-the-Shelf Application Implementation; Infrastructure Replacement; etc.*

Short Project Description:

Internal Contact Name: *This should be the Project Manager or other individual who can be contacted for information about this project.*

Process

Briefly describe the process used to gather information for the Post-Implementation Review including:
Review of project files;
Project Steering Committee survey;
Project Team survey; and,
Lessons learned meeting(s).

It would also be helpful to highlight any unusual factors or issues (which might have either positively or negatively affected the project) should be kept in mind when examining the Post- Implementation Review report for this project.

2. Overall Project Evaluation

This section should present a summary of the actual performance of the project against the planned performance. More specifically, it should outline:

- *Objectives: Actual performance in relation to the achievement of the planned project objectives.*
- *Project Schedule: Actual performance of the project against the project schedule.*
- *Project Budget: Actual performance of the project against the project budget.*

.

As well, this section should include a summary of the major project successes and challenges.

3. Scope and Deliverables (Quality Analysis)

This section should describe the actual performance of the project in relation to the planned results/deliverables and should address the quality of the deliverables. The planned project scope and deliverables as presented in the Project Plan, and approved Project Change Requests, should be included as well as the actual deliverables from the project.

With respect to the quality of project deliverables, state the original quality goals and summarize what really happened in relation to quality goals. Also note whether deliverables have been accepted/met owner expectations.

For projects that involve partners/vendors in the provision of products and services this section should state conclusions regarding whether the contractor has satisfied all obligations according to the Statement of Work and approved Project Change Requests.

Responses to questions from the Project Team Lessons Learned Survey and the Project Steering Committee Lessons Learned Survey that relate to project scope, roles and responsibilities, deliverables and quality should be summarized in this section.

4. Cost vs. Budget Analysis

This section should describe the actual cost of the project in relation to the budget. It should state the original budget, approved change requests and summarize actual costs by cost category. The following table can be completed to present the required information.

Table <#>: Budgeted and Actual Costs

Cost Category (Account Description)	Original Budget	Approved Change Requests	Revised Budget	Actual Costs	Variance
TOTAL					

- *Cost Category: Budget and actual cost information should be provided at an account level (e.g. Equipment/Material Supply; Internal Labour; External Forces) and for the project total.*
- *Original Budget: For capital projects, this information should be based on the Capital Job Cost.*
- *Approved Change Requests: Any financial impact of Project Change Requests approved by the Project Owner should be noted here. As well, for capital projects where the Divisional Vice-President has approved a budget increase[1], this change should be included.*
- *Revised Budget: Changes to the original budget resulting from approved change requests as well as re-forecasting of accounts by the project manager should be reflected in this column. The commentary in this section should briefly explain the requirement for the re-forecast (e.g. materials budget reduced to reflect results of tender).*
- *Variance: This column should present the variance between the revised budget and the actual costs.*

In addition to the financial information presented in the table, this section should reference reasons for variances and lessons learned regarding the financial aspects of the project. For example, in 2004 a number of capital projects were delivered with the assistance of an external partner while the budget for the project was developed based on the assumption that internal resources would complete delivery. Commentary for this section could reference this factor as the reason for the revisions to the internal labour and external forces accounts. A corresponding lesson learned is the requirement to determine the mix of internal and external forces for project delivery during the planning/budgeting process.

For projects involving Hydro's partner, this section should include budgeted and actual project effort for Hydro and Aliant-xwave resources.

In instances where a portion of the internal labour costs associated with the delivery of a capital project have been charged to an operating work order, these operating labour costs should be referenced in this section of the Post Implementation Review. This information can be used to assist in determining the total cost of project delivery and assisting in the budgeting of future projects.

Responses to questions from the Project Team Lessons Learned Survey, the Project Steering Committee Lessons Learned Survey and lessons learned meetings that relate to the financial aspects of the project should be summarized in this section.

[1] Based on the requirement that Divisional Vice-President approval is required when a capital job cost is exceeded by the lesser of 15% or $25,000.

5. Schedule Analysis

This section should summarize the actual performance of the project against the project schedule. It should outline the original schedule as committed in the Project Plan and adjustments to the schedule as outlined in approved Project Change Requests. It should also present the actual timelines achieved for key milestones. Any significant variances in the schedule and the reasons for these variances should be briefly stated.

Responses to questions from the Project Team Lessons Learned Survey, the Project Steering Committee Lessons Learned Survey and lessons learned meetings that relate to the project schedule should be summarized in this section.

If a project has been closed out for administrative/financial purposes but additional tasks must be completed, this section of the document should document this requirement.

6. Successes and Challenges

This section should address the successes and challenges of the project that have not been addressed in the previous sections of the Post-Implementation Review. The results of the Project Team Lessons Learned Survey and the Project Steering Committee Lessons Learned Survey can be used to identify particular themes or areas that should be the subject of further exploration at the group lessons learned meeting(s).

Appendix A outlines a series of questions that may be helpful in generating discussion about a number of different project considerations.

When identifying and presenting project successes and challenges, try and isolate specific things that worked well or caused problems. For example, rather than stating the team communicated well note that the tailgate meeting at the site prior to the RTU installation worked well.

7. Safety Performance

Present the key findings regarding safety performance for all aspects of the project. Reference the Corporate Safety and Health Program Segment 11, Safety and Health checklist.

8. Environmental Assessment

An assessment of the environmental components of project will include a review of the following where applicable:

1. Permits, approvals and letters of advice from regulatory agencies

    - Were regulatory approvals received in a timely manner? If not, were there problems during the application or review processes?
    - Were the conditions of permits and approvals reviewed for applicability to the work to be undertaken?
    - Were there any incidents of non-compliance with permit and approval requirements? If yes, explain.
    - Were completion reports or other follow-up documentation requirements of permits and approvals completed and submitted as required?

2. Environmental protection planning

    - Was an environmental protection plan developed and implemented?
    - Were mitigation and control measures effective? If no, explain.

3. Environmental emergency response planning (EERP)

    - Was an EERP developed and implemented?
    - Was there a need to enact the EERP? If yes, explain.

4. Inspection and monitoring

    - Did the contractor identify an Environmental Coordinator? If yes, was the coordinator effective? Explain.
    - Did Hydro provide an Environmental Coordinator?

5. Regulatory compliance

    - Did regulatory agencies inspect project work sites?
    - Have regulatory inspectors initiated, or indicated that they may be initiating, investigations, regulatory orders, administrative penalties, or offence charges related to any work activities? If yes, explain.

6. Rehabilitation

   - Has rehabilitation been completed? If no, explain.

9. Recommendations

List, in bullet form, the recommendations arising from the lessons learned process for this project. Consider recommendations that could be implemented to enhance the delivery of:

- *Future phases of the project (e.g. lessons learned for battery or RTU installations for one site can be applied to the next site;*
- *Future iterations of repeatable projects (e.g. lessons learned from Lotus Notes or JD Edwards upgrade can be applied to the next upgrade); and/or*
- *Other projects (e.g. lessons learned recommendations that are more generally applicable).*

For projects involving the Strategic Partner or any consultant/vendor, identify the recommendations that can assist in the planning and delivery of other projects involving external resources. These recommendations would likely focus on the processes related to engaging the consultant, planning the work and managing the delivery of the project. For example, a recommendation arising from recent partnership projects is the requirement for the partner to initiate the identification of skilled resources 1-2 months in advance of the start date for projects requiring sub-contractor resources (e.g. JDE, Showcase).

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10. Approvals

Signatures appearing below indicate a review of the document and approval of the project results as described in this document. The Asset/Business Unit Manager will decide on the positions to sign-off on the Post Implementation Report. If the positions are not listed, then add as required.

Name:		Date:
Title:	Technical Lead	
Name:		Date:
Title:	Asset Manager	
Name:		Date:
Title:	Labour Manager	
Name:		Date:
Title:	Manager T&D (TRO)	
Name:		Date:
Title:	Manager G&T (TRO)	
Name:		Date:
Title:	Project Manager	
Name:		Date:
Title	Project Owner	

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PROJECT TEAM LESSONS LEARNED SURVEY

Guidelines for Project Managers

The purpose of the lessons learned survey is to obtain feedback from a Project Team regarding how a project is proceeding/was conducted and to identify recommendations that can be used to improve the delivery of future projects or subsequent phases of projects.

This survey is intended as a template that should be adapted by Project Managers to reflect the specifics of a project. The survey has been divided into themes or sections with a series of questions relating to that theme. Project Managers are encouraged to add or delete sections and/or individual questions.

This survey can be sent to team members during or after a project but it is suggested that it be sent before any group "lessons learned" meetings. The survey is not intended to collect exhaustive data on every topic area but rather to identify the particular areas that should get special exploration in the group lessons learned meeting. As well, the survey provides an avenue for feedback from team members who may be unable to attend lessons learned meetings or who may not be comfortable offering feedback in that forum. Project Managers may also chose to provide for anonymous feedback by suggesting that team members print and return the survey through internal mail.

When documenting survey results ensure that only summary information is provided; no comments or ratings should be attributed to individuals.

Instructions to Project Teams

The purpose of the survey is to review what happened with this project and to identify what the Project Team and Hydro can learn from what happened.

Please take this opportunity to offer your views on the project. Your feedback will be combined with the feedback of other team members and a summary of the survey results will be prepared; no comments or ratings will be attributed to individuals.

You may forward your completed survey to the Project Manager via email or interoffice mail.

Newfoundland & Labrador Hydro Group of Companies

Section 1: Overall Project Success

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the project results?					
2. How satisfied are you with the way the project was performed (the process)?					
3. Did the project fulfill **schedule/time** objectives?					
4. Did the project fulfill **budget** objectives?					
5. Did the project deliver agreed **scope**?					
6. How satisfied are you with the quality of the deliverables from the Project?					

For this project, identify key things that were done right and should be continued.

1.
2.
3.

For this project, identify key things that were done wrong or could be improved.

1.
2.
3.

What unusual factors or issues (which might have either positively or negatively affected the project) should be kept in mind when examining the history of this project?

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Section 2: Roles and Responsibilities

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the explanation of your role in the project?					
2. How satisfied are you with the definition of the roles and responsibilities of other project team members?					
3. How satisfied are you with the performance of Hydro team members on this project?					
4. How satisfied are you with the support provided by the Project Steering Committee?					
5.To what extent did the Project Owner positively impact the project?					
6. How satisfied are you with the explanation of the role of the partner in this project?					
7. How satisfied are you with the way the partner resources performed on this project?					
8. How satisfied are you that the partner satisfied all obligations according to the Statement or Work and Approved Change Request?					

Comments:

Newfoundland & Labrador Hydro
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Section 3: Communication and Relationships

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the effectiveness of project team meetings?					
2. How satisfied are you with how and when the Project was commissioned to your Department?					
3. How satisfied are you that appropriate parties were informed of project status in a timely fashion?					
4. How satisfied are you with the way your efforts were recognized?					
5. How satisfied are you with the way you were involved in project decisions?					
6. How satisfied are you with the responsiveness of the partner during the planning and delivery of the project?					
7. How satisfied are that the entire team was committed to the project schedule?					

Comments:

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Section 4: Project Planning

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the way the project was defined when it began?					
2. How satisfied are you with the amount of detail in the Microsoft project work plan?					
3. How satisfied are you with that the timing and effort outlined in the Microsoft project work plan was realistic?					
4. How satisfied are you that project phases and checkpoints were adequate for project control?					
5. How satisfied are you with the opportunity you had in developing the project work plan?					

Comments:

Newfoundland & Labrador Hydro
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Section 5: Technical Approach

Note: Develop questions to reflect the type of project.

Question/Statement	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
Satisfaction with:					
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Comments:

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Section 6: Training and Documentation

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the definition of training/knowledge transfer objectives for the project?					
2. How satisfied are you with the fulfillment of the training/knowledge transfer objectives?					
3. How satisfied are you with project management documents (e.g. Project Charter, Project Plan, Project Change Requests, etc.)?					
4. How satisfied are you with product/service documents (e.g. Requirement and technical specifications; System guides and manuals; as-built documentation)?					

Comments:

Section 7: Other Comments

What were some of the greatest challenges that the project team had to work through?

For the next project, how/what would we improve on the way the project was conducted?

Feel free to add any other comments here:

Thank you for your comments!

APPENDIX A - SAMPLE DISCUSSION QUESTIONS

Overall Project Results

- Were project expectations well defined, managed and met?
- Did the project satisfy the expectations of its owner, sponsors, clients/users?
- What could have been done to have increased the successes and decreased the number of challenges/difficulties on the project?
- Did users consider the project to be on time and of high quality

Roles and Responsibilities

- To what extent did the project team complete their tasks as assigned?
- How well did the project team work together?
- How did the project team contribute to the overall outcome of the project (whether successful or not)?
- What were some of the greatest challenges that the project team had to work through? How did they manage these challenges?
- Did we have/utilize the appropriate resources?
- To what extent did the partner positively impact the project?
- To what extent did the partner negatively impact the project?
- Were the right members included in the project?
- Were the team roles and responsibilities clear?
- To what extent did the Project Owner positively or negatively impact the project?
- Did the clients/users fulfill their responsibilities to provide resources, turnaround approvals in a timely way, take part in work sessions, review and test the product, and provide accurate information?

Communication and Relationships

- Meetings: who/when/how often. How well did this work?
- Communication: who/when/how often. How well did this work?
- Were users/customers regularly updated regarding project status?
- Were project meetings runs productively and efficiently?

Project Planning

- Were project phases well planned and checkpoints adequate for control?
- Who was responsible for original plans? How did that work? Were the right people involved?
- Was the project well defined from the beginning? Was there an actual written plan? Was the Project Plan communicated? How well did that work?
- Was the plan a good one? What was good? What was missing?
- Was the plan realistic?
- How did the plan evolve over time? Was the change good or bad? How did the changes affect the project?
- Was the project activity well coordinated and did things happen according to schedule?

Partner Projects

For projects delivered in partnership with Aliant-xwave, the following points should be discussed and included in the Post Implementation Review:

- Were specific training requirements identified in the project Statement of Work? Was the source of training identified? Was required training delivered?
- Was the approach to identifying and approving project resources successful?
- Project Change Management: Comment on the number of changes in project schedule, scope and budget and any resulting Hydro/Aliant-xwave downtime.
- Were any specific knowledge transfer/best practices requirements identified in the project Statement of Work? Were the requirements addressed?
- Were roles and responsibilities between Hydro and Aliant-xwave understood by the project team? Were the agreed upon roles and responsibilities performed?
- Did vendors adhere to schedule?
- Were vendors cooperative? Flexible?
- Would you recommend the vendors used on this project for future projects?
- Did the partner contribute innovation and value to the project? Discuss why or why not.

Project Management

- Comment on the number and type of changes to project scope, schedule and budget. How were changes tracked, communicated. How well did this work? Were responses to project change requests timely and fair?
- Were the projects managed to minimize operational disruptions, or were project managers unaware of the inconvenience they may cause?
- What risks occurred on the project that were not anticipated? What was learned about risk management that will help with future projects?
- What issues were identified with the project? Were the issues well managed?

Technical Approach

- What did we learn from the technical approach to the project?
- What can be done differently next time?
- What processes should we change?
- Should we try a different technical approach?

Training and Documentation

- Documentation: For technical and project management documentation comment on the completeness and accuracy of documentation; adherence to standards and guidelines for various documents types; adherence to format requirements; technical adequacy; internal consistency throughout documents and understanding for the intended audience.
- Was the requirement for training and/or knowledge transfer clearly documented in the project plan?
- Did the right people receive the right training at the right time?
- What could have been done to improve the training and documentation aspects of the project?

Innovation

- Did the delivery of the project consider improved approaches to meeting stated requirements?
- Describe any innovations used or developed by the project.

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COMMUNICATION PLAN
PROJECT WORK

Communication Planning involves determining the information and communications needs of stakeholders. Who needs what information? When will they need it? How will the information be provided and by when? Identifying the information required by stakeholders and a suitable means of providing that information will increase project success.

Project Name:

Project Number:

Project Date:

Project Classification: ☐ **Operating** ☐ **Capital**

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1. Introduction

All projects require accurate and consistent communication paths between the Project Manager and various groups within the Project. The following document identifies the groups, the type of communication used and the frequency. The plan must be initiated by the Project Manager.

2. Project Information

Project Manager:

Project Supervisor(s):

Team Leader(s):

Team Members:

3. Communication Matrix (Internal & External)

Who needs information?	What information?	How often?	Who provides information?	Communication Medium

4. Communication Plan Approval Signatures

_____ Name: Title:

_____ Name: Title:

Newfoundland & Labrador Hydro
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POST IMPLEMENTATION REVIEW REPORT

Project Name:

Project Number:

Project Date:

Project Classification: ☐ **Operating** ☐ **Capital**

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1. Introduction

Project Information

Name of Project:

Project Owner:

Type of Project:

Short Project Description:

Internal Contact Name:

Process

2. Overall Project Evaluation

3. Scope and Deliverables (Quality Analysis)

4. Cost vs. Budget Analysis

Table <#>: Budgeted and Actual Costs

Cost Category (Account Description)	Original Budget	Approved Change Requests	Revised Budget	Actual Costs	Variance
TOTAL					

5. Schedule Analysis

6. Successes and Challenges

7. Safety Performance

8. Environmental Assessment

9. Recommendations

10. Approvals

Signatures appearing below indicate a review of the document and approval of the project results as described in this document. The Asset/Business Unit Manager will decide on the positions to sign-off on the Post Implementation Report. If the positions are not listed, then add as required.

Name:		Date:
Title:	Technical Lead	
Name:		Date:
Title:	Asset Manager	
Name:		Date:
Title:	Labour Manager	
Name:		Date:
Title:	Manager T&D (TRO)	
Name:		Date:
Title:	Manager G&T (TRO)	
Name:		Date:
Title:	Project Manager	
Name:		Date:
Title	Project Owner	

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PROJECT TEAM LESSONS LEARNED SURVEY

Guidelines for Project Managers

The purpose of the lessons learned survey is to obtain feedback from a Project Team regarding how a project is proceeding/was conducted and to identify recommendations that can be used to improve the delivery of future projects or subsequent phases of projects.

This survey is intended as a template that should be adapted by Project Managers to reflect the specifics of a project. The survey has been divided into themes or sections with a series of questions relating to that theme. Project Managers are encouraged to add or delete sections and/or individual questions.

This survey can be sent to team members during or after a project but it is suggested that it be sent before any group "lessons learned" meetings. The survey is not intended to collect exhaustive data on every topic area but rather to identify the particular areas that should get special exploration in the group lessons learned meeting. As well, the survey provides an avenue for feedback from team members who may be unable to attend lessons learned meetings or who may not be comfortable offering feedback in that forum. Project Managers may also chose to provide for anonymous feedback by suggesting that team members print and return the survey through internal mail.

When documenting survey results ensure that only summary information is provided; no comments or ratings should be attributed to individuals.

Instructions to Project Teams

The purpose of the survey is to review what happened with this project and to identify what the Project Team and Hydro can learn from what happened.

Please take this opportunity to offer your views on the project. Your feedback will be combined with the feedback of other team members and a summary of the survey results will be prepared; no comments or ratings will be attributed to individuals.

You may forward your completed survey to the Project Manager via email or interoffice mail.

Newfoundland & Labrador Hydro
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Section 1: Overall Project Success

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the project results?					
2. How satisfied are you with the way the project was performed (the process)?					
3. Did the project fulfill **schedule/time** objectives?					
4. Did the project fulfill **budget** objectives?					
5. Did the project deliver agreed **scope**?					
6. How satisfied are you with the quality of the deliverables from the Project?					

For this project, identify key things that were done right and should be continued.

1.
2.
3.

For this project, identify key things that were done wrong or could be improved.

1.
2.
3.

What unusual factors or issues (which might have either positively or negatively affected the project) should be kept in mind when examining the history of this project?

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Section 2: Roles and Responsibilities

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the explanation of your role in the project?					
2. How satisfied are you with the definition of the roles and responsibilities of other project team members?					
3. How satisfied are you with the performance of Hydro team members on this project?					
4. How satisfied are you with the support provided by the Project Steering Committee?					
5.To what extent did the Project Owner positively impact the project?					
6. How satisfied are you with the explanation of the role of the partner in this project?					
7. How satisfied are you with the way the partner resources performed on this project?					
8. How satisfied are you that the partner satisfied all obligations according to the Statement or Work and Approved Change Request?					

Comments:

Section 3: Communication and Relationships

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the effectiveness of project team meetings?					
2. How satisfied are you with how and when the Project was commissioned to your Department?					
3. How satisfied are you that appropriate parties were informed of project status in a timely fashion?					
4. How satisfied are you with the way your efforts were recognized?					
5. How satisfied are you with the way you were involved in project decisions?					
6. How satisfied are you with the responsiveness of the partner during the planning and delivery of the project?					
7. How satisfied are that the entire team was committed to the project schedule?					

Comments:

Section 4: Project Planning

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the way the project was defined when it began?					
2. How satisfied are you with the amount of detail in the Microsoft project work plan?					
3. How satisfied are you with that the timing and effort outlined in the Microsoft project work plan was realistic?					
4. How satisfied are you that project phases and checkpoints were adequate for project control?					
5. How satisfied are you with the opportunity you had in developing the project work plan?					

Comments:

Section 5: Technical Approach

Note: Develop questions to reflect the type of project.

Question/Statement	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
Satisfaction with:					
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Comments:

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Section 6: Training and Documentation

Question	Rating				
	5 Very Satisfied	4 Somewhat Satisfied	3 Neutral	2 Dissatisfied	1 Very Dissatisfied
1. How satisfied are you with the definition of training/knowledge transfer objectives for the project?					
2. How satisfied are you with the fulfillment of the training/knowledge transfer objectives?					
3. How satisfied are you with project management documents (e.g. Project Charter, Project Plan, Project Change Requests, etc.)?					
4. How satisfied are you with product/service documents (e.g. Requirement and technical specifications; System guides and manuals; as-built documentation)?					

Comments:

Section 7: Other Comments

What were some of the greatest challenges that the project team had to work through?

For the next project, how/what would we improve on the way the project was conducted?

Feel free to add any other comments here:

Thank you for your comments!

APPENDIX A - SAMPLE DISCUSSION QUESTIONS

Overall Project Results

- Were project expectations well defined, managed and met?
- Did the project satisfy the expectations of its owner, sponsors, clients/users?
- What could have been done to have increased the successes and decreased the number of challenges/difficulties on the project?
- Did users consider the project to be on time and of high quality

Roles and Responsibilities

- To what extent did the project team complete their tasks as assigned?
- How well did the project team work together?
- How did the project team contribute to the overall outcome of the project (whether successful or not)?
- What were some of the greatest challenges that the project team had to work through? How did they manage these challenges?
- Did we have/utilize the appropriate resources?
- To what extent did the partner positively impact the project?
- To what extent did the partner negatively impact the project?
- Were the right members included in the project?
- Were the team roles and responsibilities clear?
- To what extent did the Project Owner positively or negatively impact the project?
- Did the clients/users fulfill their responsibilities to provide resources, turnaround approvals in a timely way, take part in work sessions, review and test the product, and provide accurate information?

Communication and Relationships

- Meetings: who/when/how often. How well did this work?
- Communication: who/when/how often. How well did this work?
- Were users/customers regularly updated regarding project status?
- Were project meetings runs productively and efficiently?

Project Planning

- Were project phases well planned and checkpoints adequate for control?
- Who was responsible for original plans? How did that work? Were the right people involved?
- Was the project well defined from the beginning? Was there an actual written plan? Was the Project Plan communicated? How well did that work?
- Was the plan a good one? What was good? What was missing?
- Was the plan realistic?
- How did the plan evolve over time? Was the change good or bad? How did the changes affect the project?
- Was the project activity well coordinated and did things happen according to schedule?

Partner Projects

For projects delivered in partnership with Aliant-xwave, the following points should be discussed and included in the Post Implementation Review:

- Were specific training requirements identified in the project Statement of Work? Was the source of training identified? Was required training delivered?
- Was the approach to identifying and approving project resources successful?
- Project Change Management: Comment on the number of changes in project schedule, scope and budget and any resulting Hydro/Aliant-xwave downtime.
- Were any specific knowledge transfer/best practices requirements identified in the project Statement of Work? Were the requirements addressed?
- Were roles and responsibilities between Hydro and Aliant-xwave understood by the project team? Were the agreed upon roles and responsibilities performed?
- Did vendors adhere to schedule?
- Were vendors cooperative? Flexible?
- Would you recommend the vendors used on this project for future projects?
- Did the partner contribute innovation and value to the project? Discuss why or why not.

Project Management

- Comment on the number and type of changes to project scope, schedule and budget. How were changes tracked, communicated. How well did this work? Were responses to project change requests timely and fair?
- Were the projects managed to minimize operational disruptions, or were project managers unaware of the inconvenience they may cause?
- What risks occurred on the project that were not anticipated? What was learned about risk management that will help with future projects?
- What issues were identified with the project? Were the issues well managed?

Technical Approach

- What did we learn from the technical approach to the project?
- What can be done differently next time?
- What processes should we change?
- Should we try a different technical approach?

Training and Documentation

- Documentation: For technical and project management documentation comment on the completeness and accuracy of documentation; adherence to standards and guidelines for various documents types; adherence to format requirements; technical adequacy; internal consistency throughout documents and understanding for the intended audience.
- Was the requirement for training and/or knowledge transfer clearly documented in the project plan?
- Did the right people receive the right training at the right time?
- What could have been done to improve the training and documentation aspects of the project?

Innovation

- Did the delivery of the project consider improved approaches to meeting stated requirements?
- Describe any innovations used or developed by the project.

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COMMUNICATION PLAN
PROJECT WORK

Communication Planning involves determining the information and communications needs of stakeholders. Who needs what information? When will they need it? How will the information be provided and by when? Identifying the information required by stakeholders and a suitable means of providing that information will increase project success.

Project Name:

Project Number:

Project Date:

Project Classification: ☐ **Operating** ☐ **Capital**

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1. Introduction

All projects require accurate and consistent communication paths between the Project Manager and various groups within the Project. The following document identifies the groups, the type of communication used and the frequency. The plan must be initiated by the Project Manager.

2. Project Information

Project Manger:

Project Supervisor(s):

Team Leader(s):

Team Members:

3. Communication Matrix (Internal & External)

Who needs information?	What information?	How often?	Who provides information?	Communication Medium

4. Communication Plan Approval Signatures

_____ _____

Name: Name:
Title: Title:

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J D EDWARDS
WORK REQUESTS / WORK ORDERS

1. **What is a Work Request?**

   A request to do work. The request simply describes the work that needs to be done, identifies the location of the work, and the piece of equipment or system that the work is required on.

2. **How do I initiate the Work Request?**

   If you have been trained in the JD Edwards Maintenance Module and you have access to a computer, you can simply initiate the Work Request yourself. If you are not familiar with JD Edwards and Work Requests, should contact the appropriate Regional Planning Department, a Control Room or a Control Centre and give them the Work Request information and ask them to generate the request. Provide your name in case extra information is required.

3. **What happens to the Work Request?**

   An Asset/Business Unit Manager reviews the request. If the Manager doesn't see a need for the work, it will be rejected and the reason communicated to the originator. If it is accepted, it will be prioritized and approved, making it an official Work Order.

4. **What is a Work Order?**

   An approved work request used to request, plan, schedule, track and report on a work activity.

5. **What type of work do we use Work Orders for?**

   In core business we use work orders for all work that require internal resources (people, equipment, material etc). Work orders are required for the five types of work (corrective, preventive, non-maintenance, operating and capital projects.

6. **What is the purpose of Work Orders?**

The Work Order system provides the most highly leveraged tool a maintenance force can possess. Work Orders have many useful purposes:

- To identify, prioritize, keep track off and manage the execution of work.
- To identify resources (labour, material, tools, etc.).
- To track and manage cost.
- To track and manage work.
- To procure goods and services.
- To capture equipment history.
- To organize work into different status categories (status flows).
- To plan and schedule work.
- To link cost and Work Order history to assets.
- To build resource plans.
- To manage backlog.
- To gather data and analyze equipment failures.
- Capacity to drill into Work Orders to explain unacceptable budget variances.
- Work Order information can be used for future identical or similar jobs.
- Great for comparing estimates/actuals/budgets, etc.
- Using JD Edwards Work Order system provides corporate visibility.

7. **Are we presently using Work Orders for operating and capital project work?**

Unfortunately, it is an area where Work Orders receive minimal use.

8. **Should the corporation be using Work Orders for operating and capital project work? Why?**

Yes, we should be using Work Orders for all work including operating and capital project work, for all the reasons listed above (in Questions 6).

9. **We have been managing project work for years without Work Orders. Why do we need to use Work Orders now?**

Today budgets, cash flow sheets, schedules and on-site supervision is used to manage and control project work. These tools will still be used but we need to interface these tools with the Work Order system so we can also take advantage of the benefits the Work Order has to offer.

10. **Since Work Orders are going to be used for operating and capital projects, where do I as Project Engineer or Project Manager begin?**

In future, capital and operating projects will be approved 6-12 months in advance of execution. The plan will contain valuable information such as project objectives, project work breakdown structure, project schedule, resource plan, etc. When the plan has been reviewed and signed-off on by customer, the Work Order set up can begin.

11. **What is my role as Project Manager in Work Order set up?**

Your role as Project Manager at this stage is to engage the Regional Planning Department in the Work Order set up process. As a team you will determine the number of Work Orders required to manage and control the execution of the project. The number of Work Orders will be closely linked to the high level activity listing in the work breakdown structure.

12. **Do I as Project Manager need to input the Work Order and all applicable work order information, i.e. labour by craft, material, etc.?**

It is important to know how to create Work Orders, add parts and labour, etc., but if there are multiple Work Orders with lengthy parts lists, etc., the Regional Planning Department will assist.

13. **What training do I as Project Manager need to become proficient in JD Edwards?**

JD Edwards training for engineers, project managers and project engineers is the responsibility of the applicable manager/director. Execution of JD Edwards training is not the responsibility of the Work Execution Process Team but identifying JD Edwards training objectives for Work Execution participants is within our mandate.

JD Edwards Basic Training

Participants must know:

1. How to create a Work Request.
2. How to add crafts to a Work Order.
3. How to add parts to a Work Order.
4. How to add account code structure to a Work Order.
5. How to locate and select asset number to a Work Order.
6. Five types of Work Orders and their number designations.
7. How to create an operating and capital project Work Order (procedure).
8. Work Order status flows.
9. How to do job status inquiry.
10. How to find work orders using different search prompts, i.e. department, planner, organization, asset number, work order status, etc.
11. How to do a Work Order backlog inquiry.
12. How to use cost by work order screen.
13. How to use job status inquiry screen.
14. How to do inventory search.
15. How to do a parts status inquiry.
16. How to find commodity codes for non-stock items.
17 How to view/enter on-line requisition entry.
18. How to set up 8-digit stock number (goods and services procedure).
19. Code of account structure for operating and capital.
20. How to do T1 budget entry.
21. How to do an account balance inquiry.
22. Other financial inquiries.

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Muskrat Falls Staffing Plan

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Disclaimer

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Muskrat Falls Staffing Plan

Section I Executive Summary

Nalcor Energy (Nalcor) requested assistance from Navigant Consulting, Inc. (Navigant) in determining the optimal operations and maintenance (O&M) staffing plan for the 824 MW Muskrat Falls project.

Methodology and Key Findings

Navigant used its GKS Hydro benchmarking program and a regression analysis as the framework for analyzing data. Navigant's approach consisted of the following tasks:

Key findings for each of these tasks are summarized as follows:

Task 1: Identify peer plants for Muskrat Falls.

- The peer plants for most functional areas consists of hydro plants between 250 MW and 3,000 MW with fully-staffed control rooms.
- The peer group unadjusted median staffing is 81.8 Full-Time Equivalent (FTE) employees, including both in-house and subcontractor employees.

Task 2. Identify differences between Muskrat Falls and peer plants.

- Unique characteristics of Muskrat Falls were identified that result in total adjustments of 12.1 FTE to the benchmark.

Task 3. Develop a long term steady state staffing plan for Muskrat Falls.

- The adjusted median benchmark for steady-state operation = 81.8 + 12.1 = 93.9 FTE.
- The adjusted benchmark ranges from 79.9 to 107.9 FTE, based on 95% confidence level curves from the regression analysis.

Task 4. Develop a staffing plan for Muskrat Falls for the pre-operational and startup periods.

- Approximately 70% of the workforce should be in place by the end of 4Q18, approximately 80% by the end of 2Q19, and essentially all by the end of 4Q19.
- There are several potential areas of long-staff optimization which collectively may result in a net reduction of ~30 FTE over a period of up to 10 years.

Recommendations

Navigant offers the following recommendations for Nalcor and subcontractor staffing at Muskrat Falls.

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Muskrat Falls Staffing Plan

- Nalcor should target initial staffing levels within the range of adjusted benchmarks as shown in Table 11. Nalcor's current budget (110.9 FTE including subcontractors) is reasonably consistent with the high end of the range (107.9 FTE).

Table ES-1. Adjusted benchmarks (FTE)

Functional Area	Midpoint	Low	High
Operations	16	11	21
Plant Maintenance	23	19	27
Waterways & Dams	14.3	12.3	16.3
Buildings & Grounds	6.4	6.4	6.4
Investment	7	5	9
Support	13.4	12.4	14.4
Public Affairs & Regulatory	13.8	13.8	13.8
Total	93.9	79.9	107.9

- Areas with the greatest opportunities for budget reductions are in Support (e.g.,as finance roles of tax, treasury, risk, and insurance) and Operations (e.g., control room operators).
- Optimizations in Operations, Plant Maintenance, Waterways & Dams, Support, and PA&R staffing should be considered in a phased approach as operations stabilize.

Section II Background

Nalcor Energy (Nalcor) is constructing an 824 megawatt (MW) hydroelectric generating facility at Muskrat Falls on the lower Churchill River in Newfoundland and Labrador. The Muskrat Falls plant will have the following characteristics:

- Run-of-river conventional hydroelectric facility;
- 4 generating units, 206 MW each;
- Net Capacity Factor 65%-70%;
- Currently under construction, with the 1st turbine scheduled for commercial operation in 2Q19 and the 4th turbine in 3Q20;
- Remote site, approximately 40 km from Happy Valley/Goose Bay, a community of approximately 5,000 people;
- Will be connected to a DC converter station located at the site;
- Will initially have a fully-staffed control room, and as and as experience and efficiencies are gained, will be evaluated for staff optimization opportunities and possible automation.

Nalcor requested assistance from Navigant Consulting, Inc. (Navigant) in determining the optimal operations and maintenance (O&M) staffing plan for the Muskrat Falls project. The project includes the following key objectives:

- Provide a proposed steady-state staffing plan which represents the recommended full time equivalent (FTE) employees for Muskrat Falls for each functional area, with median, low, and high cases;
- Identify the staffing impact of optimization initiatives;
- Provide recommendations on when staff should be brought on-board to support the pre-operational, start-up, and steady-state periods.

Section III Methodology

Navigant used its GKS Hydro®[1] benchmarking program as the framework for analyzing data for the Muskrat Falls Staffing Plan. Navigant's approach consisted of the following tasks, which are discussed in greater detail below:

Task 1: Identify peer plants for Muskrat Falls. The peer plants for Muskrat Falls were selected from the approximately 30 plants in the GKS Hydro® data base with generating capacity between 250 MW and 3,000 MW that have fully-staffed control rooms. We determined the appropriate peer groups for staffing comparisons in each of the following functional areas shown in Table 1. Functional area definitions are shown in Appendix A.

Table 1. Hydro Plant functional areas

Operations
Plant Maintenance
Waterways & Dams Maintenance
Buildings & Grounds Maintenance
Support
Investment (non-routine projects that are performed every 10+ years)
Public Affairs & Regulatory

The peer groups include a mix of competitive industry and government owned utilities.

Navigant has determined the segmentation scheme for each functional area based on a regression analysis that identifies peer groups with common data characteristics. The segments are defined by the metric(s) that is the most significant cost driver for that function. As an example, our analysis has shown that station capacity and the degree of automation are the most significant drivers for Operations costs and thus we typically use the following peer groups for Operations:

- Fully Staffed Control Room (all sizes)
- Small, Automated: Average Station Capacity <100 MW
- Medium-Large, Automated: Average Station Capacity >=100 MW

Since Muskrat Falls will initially have a fully staffed control room, we benchmarked Operations staffing in the Fully Staffed Control Room segment, even though the plant design allows for possible remote control.

Task 2. Identify differences between Muskrat Falls and peer plants. Navigant, with assistance from Nalcor, identified any differences from the information provided about Muskrat Falls' design that could affect staffing. As an example, Muskrat Falls has a significant amount of roads to maintain compared to most of the peer group plants that

[1] GKS Hydro® benchmarking is a web-enabled subscription benchmarking service that provides a diagnostic assessment of each participating company's performance relative to industry peers. GKS Hydro® was first implemented in 1994 and includes data from 44 companies on 5 continents. The current GKS Hydro® data base includes data from approximately 1,846 generating units at 528 hydroelectric stations (including Nalcor's Churchill Falls Generating Station) with more than 107 GW of generating capacity.

require additional staffing for snow removal and road maintenance.

Navigant then conducted a site visit to better understand the unique characteristics of Muskrat Falls compared to other plants in the peer group. During the site visit Navigant and Nalcor discussed current plans for staffing the generation plant as well as which resources can be shared between transmission and generation.

Task 3. Develop a long term steady state staffing plan for Muskrat Falls. Navigant then combined information in the GKS Hydro® database with design and operating characteristics and unique factors at Muskrat Falls that could impact staffing. We used regression analysis to develop benchmark staffing levels for each of the hydro functional areas that are shown in Table 1.

The modeling process involves the use of multivariate regression models to normalize data from other plants for key factors that influence staffing such as plant size, number of units, age, plant usage, and total company generation capacity. Table 2 shows the various factors that we tested for significance in the regression analysis. Table 13 in Appendix B shows the data used as inputs for the Muskrat Falls staffing model.

Table 2. Factors tested for statistical significance

Station group capacity (MW)	Avg. station capacity
Station age (weighted avg.)	Avg. unit size
WW&D age (weighted avg.)	Fully staffed or automated
Capacity factor	Multi-skilled workforce (Y/N)
# Stations	Head (weighted avg.)
# Units	Dam surface area
# Dams	Water passed
Avg. water year factor	Building space

We made adjustments to the benchmarks based on factors that are unique to Muskrat Falls and outside management's control.

We produced an initial (post-startup and training period) staffing plan for Muskrat Falls based on medians of the peer groups' adjusted staffing levels for each function. A flow diagram of this process is shown in Figure 1.

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Muskrat Falls Staffing Plan

Figure 1. Developing benchmarks from regression analysis

The recommended number of FTE employees includes both in-house and contractor employees. The reasoning is that each company has a different contracting strategy that affects the mix of in-house vs. contracted employees but it does not affect the total number of employees required for each function. Nalcor should apply its contracting philosophy to the benchmark numbers to determine an appropriate split between company and contractor personnel.

Task 4. Develop a staffing plan for Muskrat Falls for the pre-operational and startup periods. Navigant produced a plan showing the recommended hire date for each of the employee categories in the long term staffing plan. The hire dates take into account the level of training needed for either the functional area in general or specific to Muskrat Falls operations.

Section IV Findings

Benchmark Staffing Levels

Navigant produced linear regression models to determine the benchmark steady-state staffing levels[2] for each functional area. Navigant's staffing model characteristics and results are summarized in Table 3.

Table 3. Staffing model characteristics

Functional Area	Unit Types Modeled	# Data Points	Model R^2	Model Factors	Benchmark FTE
Operations	Conventional, 250-3,000 MW ROC[3], Fully Staffed	27	69%	# Units, Average Unit Size	16
Plant Maintenance	Conventional, 250-3,000 MW ROC, Fully Staffed	27	68%	ROC, # Units	23
Waterways & Dams	Conventional, 250-3,000 MW ROC, Fully Staffed	27	69%	# Head Gates, # Spillway Gates, # Dams	7
Buildings & Grounds	Conventional, All sizes	214	72%	Building Space (Square meters)	3
Investment	Conventional, <25 years old	23	58%	ROC, Station Average Age	7
Support (on-site + off-site)	Conventional, All sizes	214	79%	Total Station Group FTE (less Support)	12

Navigant identified three areas that have unique factors to Muskrat Falls, impacting the FTEs compared to most peer group plants. For each area, we determined an adjustment factor, which is the difference between the currently budgeted staffing level and the staffing level that would be expected in normal conditions. Table 4 provides a list of the adjustments to benchmarks and a discussion of their justification. Total adjustments for the three identified areas are 12.1 FTE.

[2] Staffing in the first couple of years of operation are typically higher than steady-state levels.
[3] ROC = Station Group Real Operating Capacity (MW).

Table 4. Adjustments to benchmarks

Functional Area	Description	Incremental FTE
Waterways & Dams	Additional debris management is needed since there was no clearing of the reservoir and there will be large amounts of waste wood accumulating in the reservoir and the trash racks until stabilization of the reservoir occurs. The soil conditions are also very sandy which increases the amount of debris. (10.4 FTE budget vs. 3.1 FTE expected in normal conditions)	7.3
Buildings & Grounds	Additional snow removal and road maintenance due to the large site size, long access road, and northern climate conditions compared to the peer group (4.4 FTE budget vs. 1.0 FTE expected in normal conditions)	3.4
Support	Additional site security during initial years of operation (2.7 FTE budget vs. 1.3 peer group median)	1.4
Total		12.1

Table 5 summarizes the benchmarked staffing levels before and after adjustments for Muskrat Falls. The total benchmarked staffing level before adjustments is 81.8 FTE, using the appropriate figures in the far right column of Table 3 and the inclusion of PA&R. After adjustments of 12.1 FTE, the adjusted total benchmark is 93.9 FTE, as shown in the bolded middle column of Table 5.

Table 5. Benchmarked staffing levels (FTE)

Functional Area	Before Adjustments			Adjust-ments	Adjusted Totals		
	In-House	Subs	Total		Mid	Low	High
Operations[4]	14.1	1.9	**16**	0	**16**	11	21
Plant Maintenance	19.8	3.2	**23**	0	**23**	19	27
Waterways & Dams	7	0	**7**	7.3	**14.3**	12.3	16.3
Buildings & Grounds	2.4	0.6	**3**	3.4	**6.4**	6.4	6.4
Investment	1.4	5.6	**7**	0	**7**	5	9
Support	11	1	**12**	1.4	**13.4**	12.4	14.4
Public Affairs & Reg.[5]	5.1	8.7	**13.8**	0	**13.8**	13.8	13.8
Total	60.7	21.1	**81.8**	12.1	**93.9**	79.9	107.9

Navigant also produced low and high adjusted benchmarks for each functional area representing 95% confidence level curves based on the regression analysis. The two columns on the right side of Table 5 show these low and high adjusted benchmarks, with totals ranging from a low of 79.9 FTE to a high of 107.9 FTE.

[4] Assumes fully staffed control room
[5] The PA&R benchmark is based on information specific to Muskrat Falls instead of a regression of peer group data and therefore does not have any adjusted totals

Currently Budgeted Staffing Levels

Nalcor provided input on in-house and subcontractor staffing levels that are currently budgeted for the Muskrat Falls generation station. Total in-house staffing for all functional areas is currently budgeted at 60.6 FTE. In cases where personnel are supporting both the generation station and transmission facilities, only the portion of their time that is allocated to the generation station are included.

Total subcontractor staffing is currently estimated to be 50.3 FTE. The use of subcontractors will allow for increased flexibility in resourcing as longer term requirements continue to be refined as learnings are gained through the operations and maintenance of the assets. The staffing for each subcontract was determined based on the dollar value of the contract, the estimated percentage of labor in the contract, and the estimated average salary for that type of contractor in the Happy Valley/Goose Bay area:

- (Subcontractor FTE) = (Subcontract $ per year)(% labor)/(Average salary $ per year)

Table 6 shows a comparison of adjusted benchmarks (from Table 5) to the FTE that are currently budgeted for each functional area. As shown in the middle bolded column of Table 6, Nalcor is currently budgeting an estimated total of 110.9 FTE for all functional areas. As shown in the far right column of Table 6, this total is 17 FTE higher than the adjusted midpoint benchmark of 93.9 FTE. The currently budgeted total is reasonably consistent with the adjusted benchmark range of 107.9 FTE.

Table 6. Variances vs. benchmarks

Functional Area	Adjusted Benchmark FTE			Currently Budgeted FTE[6]			Budget vs. Benchmark
	Midpoint	Low	High	Total	In-House	Subs	
Operations	**16**	11	21	**25.1**	20.7	4.4	**9.1**
Plant Maintenance	**23**	19	27	**17.9**	12.6	5.3	**-5.1**
Waterways & Dams	**14.3**	12.3	16.3	**15.4**	1.5	13.9	**1.1**
Buildings & Grounds	**6.4**	6.4	6.4	**11.4**	1.5	9.9	**5**
Investment	**7**	5	9	**3.6**	3.6	0	**-3.4**
Support	**13.4**	12.4	14.4	**23.7**	16.9	6.8	**10.3**
PA&R	**13.8**	13.8	13.8	**13.8**	3.8	10	**0**
Total	**93.9**	79.9	107.9	**110.9**	60.6	50.3	**17**

In reviewing the far right column of Table 6, the two areas that have the greatest variance to the adjusted benchmark are Support (with a variance of 10.3 FTE) and Operations (with a variance of 9.1 FTE). These variances are explained as follows:

- *Support*. The largest contributor to Nalcor's current budget for Support functions is 5 FTE for finance functions such as tax, treasury, risk, and insurance. This level of support is likely needed since Muskrat Falls is owned and managed by a complex structure of corporate entities that requires additional support in these areas.

- *Operations*. The largest contributor to Nalcor's current budget for Operations functions is 10 FTE for control room operators (CROs). This level of staffing is

[6] All figures represent head count requirements in all locations, not just at the generation plant.

roughly twice the median used in peer group control rooms based on steady-state operation, as shown in the first row of Table 7. Since Muskrat Falls has a capacity of 824 MW, it could be compared with the first column of Table 7 which includes control rooms that control <1 GW. Those control rooms typically have 4 to 5 total CROs compared to 10 for Muskrat Falls. However, since Muskrat Falls is the primary generation plant for Island Interconnected customers, it could be compared with the 2nd column of Table 7, which is comprised primarily of control rooms that control entire regions. Those control rooms often have 20 or more total CROs, which is considerably more than Muskrat Falls. Those control rooms typically control many more units than the 4 units at Muskrat Falls, as shown by their high Units per CRO ratios in the bottom two rows of Table 7.

Table 7. Control room staffing

Metric	Control rooms that control <1 GW	Control rooms that control >=1 GW	Currently budgeted for Muskrat Falls
Median Total CROs (FTE)	5	11	10
Median CROs per shift (FTE)	1.5	2	2
Median Units per Total CRO	0.9	2.0	0.4
Median Units per CRO per shift	4.5	8.7	2.0

CRO = Control Room Operator
Source: 2018 survey of GKS Hydro subscribers

As shown in the first two rows of Table 6, Nalcor's initial staffing budget for Operations + Plant Maintenance is 4.0 FTE higher than the midpoint of the adjusted benchmark.[7] Nalcor will explore optimization opportunities as experience and efficiencies are gained through operations in an effort to decrease this variance, as shown on pages 13-14.

Staffing Schedule

Figure 2 and Table 8 show the recommended adjusted benchmarks by quarter from the 2nd quarter of 2018 (2Q18) to the 4th quarter of 2020 (4Q20). Figure 2 shows that there are two time periods with significant hiring (when the curve is the steepest): (a) between 2Q18 and 4Q18, so that key positions will be in place up to 6 months prior to initial operations, and (b) between 2Q19 and 4Q19, consisting primarily of major subcontracts for debris management and environmental compliance. Approximately 67% of the workforce (63 FTE) should be in place by the end of 4Q18, approximately 77% (72 FTE) by the end of 2Q19, and essentially all (93 FTE) by the end of 4Q19.

[7] Variance in Operations + Plant Maintenance = Variance in Operations + Variance in Plant Maintenance = 9.1 - 5.1 = 4.0 FTE.

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Muskrat Falls Staffing Plan

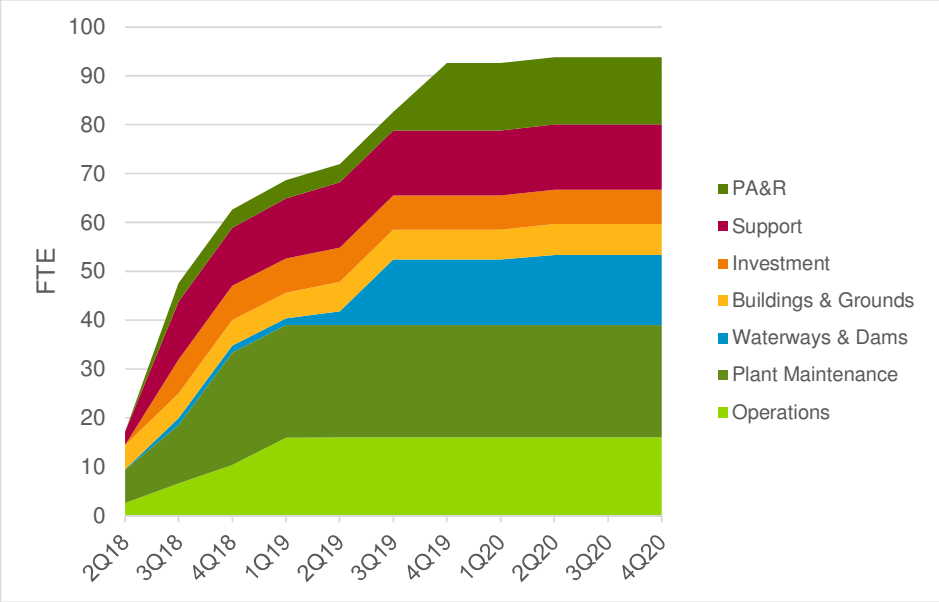

Figure 2. Adjusted benchmarks by quarter

Table 8. Adjusted benchmarks by quarter (FTE)

Functional Area	2018			2019				2020			
	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Operations	3	7	10	16	16	16	16	16	16	16	16
Plant Maint.	7	12	23	23	23	23	23	23	23	23	23
WW&D	0	1	1	1	3	13	13	13	14	14	14
B&G	5	5	5	5	6	6	6	6	6	6	6
Investment	0	7	7	7	7	7	7	7	7	7	7
Support	3	12	12	12	13	13	13	13	13	13	13
PA&R	0	4	4	4	4	4	14	14	14	14	14
Total	17	48	63	69	72	83	93	93	94	94	94

Figure 3 and Table 9 show currently budgeted FTEs by quarter for the same time period. The numbers are slightly higher than those shown in Figure 2 and Table 8, but the shapes of the curves are the same. Approximately 66% of the workforce (73 FTE) should be in place by the end of 4Q18, approximately 79% (88 FTE) by the end of 2Q19, and essentially all (109 FTE) by the end of 4Q19.

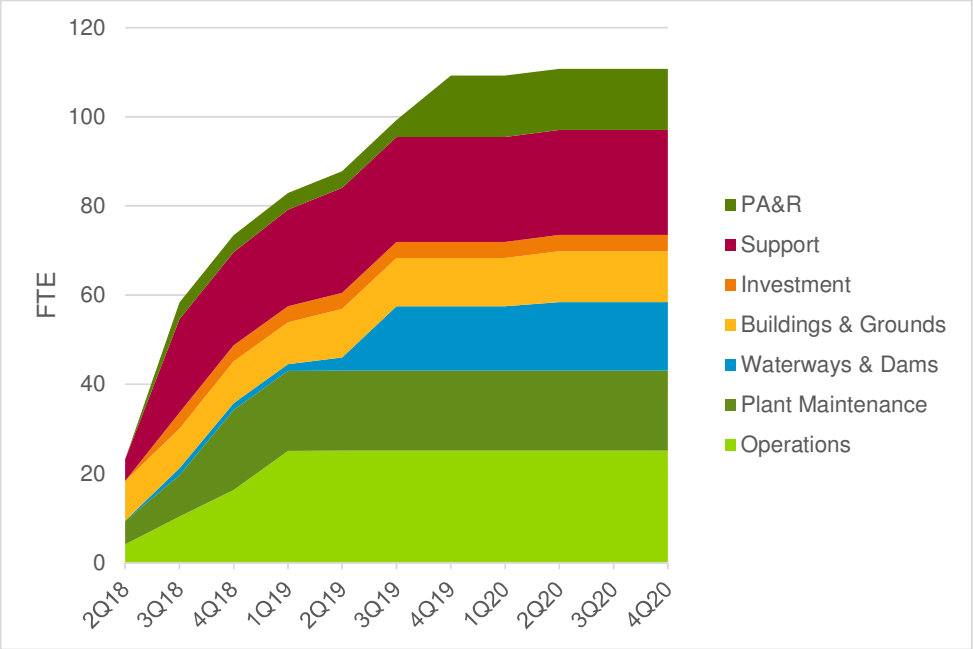

Figure 3. Currently budgeted FTEs by quarter

Table 9. Currently budgeted FTEs by quarter

Functional Area	2018			2019				2020			
	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Operations	4	10	16	25	25	25	25	25	25	25	25
Plant Maint.	5	9	18	18	18	18	18	18	18	18	18
WW&D	0	2	2	2	3	14	14	14	15	15	15
B&G	9	9	9	9	11	11	11	11	11	11	11
Investment	0	4	4	4	4	4	4	4	4	4	4
Support	5	21	21	22	24	24	24	24	24	24	24
PA&R	0	4	4	4	4	4	14	14	14	14	14
Total	23	58	73	83	88	99	109	109	111	111	111

Supporting data for Figure 3 and Table 9 can be found in Appendix C, which shows all currently budgeted positions and their recommended start dates.

Opportunities for FTE Optimization

Nalcor has identified several potential areas for long-term staff optimization. Table 10 shows seven areas of potential optimization in Operations, Plant Maintenance, Waterways & Dams, Support, and Public Affairs & Regulatory. Some of these optimizations could occur relatively soon (e.g., combining operations for the generation plant and the DC converter station after 2-3 years of operation), while others will be reviewed as experience and efficiencies are gained during initial set up and ongoing operations. (e.g., the decrease in debris

management is dependent on the pace of the stabilization of the reservoir which is unknown).

Table 10. Potential areas for long-term staff optimization

Functional Area	Description	Potential Optimization
Operations (step 1)	Combining operations for the generation plant and the DC converter station	-2 FTE after 2-3 years of operation
Operations (step 2)	Corporate philosophy change to decrease from 2 to 1 CRO per shift	-5 FTE after 3-5 years
Operations (step 3)	Staffed control room on day shift only	-2 FTE after 5-7 years
Plant Maintenance	May be needed if corrective maintenance requirements increase	+5 FTE after 3-5 years
Waterways & Dams	Less debris management	-7.3 FTE after stabilization of the reservoir
Support	Less security requirements during initial years of operation	-1.7 FTE after 3-5 years
Public Affairs & Regulatory	Less environmental monitoring	-6-8 FTE after 3-5 years

Note that possible optimization initiatives are likely to be reflected in the subcontractor count rather than in-house FTE. Even without optimization, the mix between in-house and subcontractors is likely to change as the labor market softens.

As previously mentioned, Nalcor's initial staffing budget for Operations + Plant Maintenance is 4.0 FTE higher than the midpoint of the adjusted benchmark. Nalcor will review opportunities to optimize Total Operations + Plant Maintenance staffing in a 3-step process, summarized as follows:

- *Initial Operation* staffing levels are planned for the end of 1Q19. Certain Operations positions will be staffed with shorter term engagements to allow for increased flexibility in staffing levels. Plant Maintenance staffing levels are lower than the benchmark due to some maintenance functions being covered by warranty.
- *Step 1* results from combining generation and DC converter station operations, which is expected after 2-3 years of operation. As expected reliability is demonstrated, Nalcor will consider moving from the rotational model for the converter station operators (based out of Soldiers Pond) to merging those positions into the generation model. The impact on staffing will be -2 Operations FTEs.[8]
- *Step 2* results from (a) exploring a move from 2 to 1 CRO per shift and (b) increased maintenance requirements after the warranty period, which is expected after 3-5 years of operation. Item (a) would be a new ongoing practice for Nalcor[9] and will require active dialogue with stakeholders. The impact will be a reduction of 5 FTE in Operations which would allow for a similar increase in Plant Maintenance.

[8] The number of Operations employees on the generation plant payroll may not decrease in Step 1, but 2 FTE within that group will be charging time for operation of the DC converters and therefore are not included in the generation FTE count.
[9] There are special cases when operators work alone if they call in at 2 hour intervals.

- *Step 3* results from staffing the control room on day shift only. This change would be dependent on continued and sustained reliable operation, which is expected after 5-7 years of operation. Coverage of 7 days/week on day shift can be handled by 3 CROs, which corresponds to a net impact of -2 FTE CROs.

The above steps do not include analysis of some of the challenges to be worked with stakeholders including IBEW and Transmission Operations.

Table 11 summarizes the staffing impact of the optimization process described above. The bottom row of Table 11 shows that the variance from the midpoint adjusted benchmark for Operations + Plant Maintenance staffing will decrease from +4 to 0 after completion of the 3-step process.

Table 11. Operations and Plant Maintenance optimization

(FTE)	Initial	Step 1	Step 2	Step 3
CROs	10	10	5	3
Operations (including CROs)	25	23	18	16
Plant Maintenance	18	18	23	23
Total Opns + Plant Maintenance	43	41	41	39
Total O&M vs. midpoint benchmark	+4	+2	+2	0

Nalcor should consider the following additional items when determining potential staff optimization:

- *System reliability*. Muskrat Falls represents a significant portion of the system generation capacity, which increases the need to maintain high plant availability. This is not the case for many of the peer group plants with control rooms that control <1 GW of capacity. Nalcor may want to continue its philosophy of staffing the control room with 2 CROs per shift as a risk reduction measure, since two operators can respond to potential outage events more quickly than a single operator.

- *Corporate governance*. Muskrat Falls is owned and managed by a complex structure of corporate entities that requires additional support in areas such as accounting, tax, treasury, risk & insurance, and regulatory. This additional complexity could be considered either justification for higher staffing levels in these areas or opportunities for efficiency improvement, since these areas contribute to the highest variance from the benchmark.

- *Subcontractors*. The use of subcontractors across a variety of functions will allow for increased flexibility in resourcing and provide potential optimization opportunities. As longer term requirements are refined as learnings are gained through the operations and maintenance of the assets, contract resources can be altered to realize optimizations.

Section V Recommendations

Navigant offers the following recommendations for Nalcor and subcontractor staffing at Muskrat Falls.

- Nalcor should target initial staffing levels within the range of adjusted benchmarks as shown in Table 12. Nalcor's current budget (110.9 FTE including subcontractors) is reasonably consistent with the high end of the range (107.9 FTE).

Table 12. Adjusted benchmarks (FTE)

Functional Area	Midpoint	Low	High
Operations	16	11	21
Plant Maintenance	23	19	27
Waterways & Dams	14.3	12.3	16.3
Buildings & Grounds	6.4	6.4	6.4
Investment	7	5	9
Support	13.4	12.4	14.4
Public Affairs & Regulatory	13.8	13.8	13.8
Total	93.9	79.9	107.9

- Areas with the greatest opportunities for budget reductions are in Support (e.g., finance roles of tax, treasury, risk, and insurance) and Operations (e.g., control room operators).
- Approximately 70% of the workforce should be in place by the end of 4Q18, approximately 80% by the end of 2Q19, and essentially all by the end of 4Q19.
- Optimizations in Operations, Plant Maintenance, Waterways & Dams, Support, and PA&R staffing should be considered in a phased approach as operations stabilize.

Appendix A Function Definitions

Operations

Definition All activities associated with the day-to-day operations of the station.

Scope All activities listed below, whether performed by company personnel or contractors, operations, maintenance, or support personnel, irrespective of whether these personnel are part of the station's budget.

Activities Control room operations

- Monitoring plant operations from the control room
- Coordination with system operations
- Response to alarms
- Stand-by time
- Collection of operations and regulatory data
- Outage scheduling and coordination
- Generation dispatch

Waterway operations

- Hydraulic dispatch
- Ice breaking
- Waterway patrol
- Water flow monitoring
- Water Management

Station operations

- Response to alarms
- In-plant switching
- Load transfer
- Travel time
- Stand-by time
- Writing instructions, obtaining clearances
- Environmental and safety inspections
- Emergency generator
- Station service throwover

Supervision, clerical, technical and non-project engineering support

- All technical and engineering support related to operations
- Supervision
- Clerical support

Costs Nonlabor costs include:

- Materials used to support the above activities
- Clothing and safety apparel
- Water management costs

!

NOTES:

1. Inspections performed by operators are categorized as Station Maintenance. Account for all time spent on the following types of inspections under Station Maintenance:
   - Check equipment readings
   - Checks for leaks and spills
   - Walk-throughs
   - Exercising of equipment (fans, pumps, etc.)
2. Account for fleet and boat costs under On-Site Support or Off-Site Support.

Station Maintenance

Definition All activities associated with the maintenance of rotating equipment and non-rotating electrical components of the plant, from and including the headgate or final valve up to the generator step-up transformer (GSU).

Scope All activities listed below, whether performed by company personnel or contractors, operations, maintenance, or support personnel, irrespective of whether these personnel are part of the station's budget.

Activities Station protection, controls and communication links maintenance

- Calibration and functional testing of plant relaying and controls
- Repair and troubleshooting of all station system communication links and systems

Turbine/generator maintenance

- Preventive/predictive maintenance
- Corrective maintenance
- Station inspections with checklist (often performed by operators)
- Diagnostic tests
- Minor maintenance with equipment out-of-service
- Periodic inspections of the equipment out-of-service
- Governor pump maintenance/repairs
- Brake shoe maintenance
- Inspect bearings
- Exciter maintenance

Civil/mechanical maintenance performed within the plant

- Headgate maintenance
- Draft tube/runner maintenance
- Crane maintenance
- Powerhouse breaker mechanism inspections
- Shop personnel that support Station Maintenance
- Stores personnel that support Station Maintenance
- Painting of equipment

Switchyard maintenance

- GSU maintenance

- Drawing oil samples, interpreting and performing test results
- All Doble/power factor and excitation testing
- All breakers, switches and line maintenance on the plant side of the GSU
- Cleaning up oil spills

Supervision, technical and non-project engineering support

- Supervision
- All technical and engineering support related to maintenance

Costs

Nonlabor costs include:

- All replacement parts
- Materials used to support the above activities, including consumables
- Outside labs, analysis or leased equipment
- Clothing and safety apparel
- Equipment

!

NOTES:

1. Include scheduled and unscheduled maintenance charged to general maintenance accounts but specifically **EXCLUDE** the following:
   - Maintenance associated with projects that were charged to a specific project charge number that was distinct from general blanket accounts **AND**
   - Maintenance associated with major overhaul work (i.e., a major overhaul is a significant reconditioning of the units designed to return them to their "like new" condition. A major overhaul typically lasts 12 weeks or longer and occurs at cycles longer than 10 years).

   Account for this maintenance work under Investment.
2. **INCLUDE** maintenance accomplished during an outage.
3. Account for maintenance upstream of the headgate or final valve under Waterway and Dam Maintenance.
4. Account for all maintenance of the switchyard on the high side of the GSU under Functions Not Benchmarked.
5. Account for fleet costs under On-Site Support or Off-Site Support.
6. Account for all maintenance of buildings and structures under Buildings and Grounds Maintenance.
7. Account for all maintenance of parks, recreational facilities, fish hatcheries, etc., under Public Affairs & Regulatory.

Waterways and Dams Maintenance

Definition All activities associated with maintenance of the waterways, dams and penstocks upstream of the headgate or final valve.

Scope All activities listed below, whether performed by company personnel or contractors, operations, maintenance, or support personnel, irrespective of whether these personnel are part of the station's budget.

Activities Activities include:

Dam maintenance

- Work required to comply with FERC dam safety requirements
- Dam instrumentation maintenance
- All civil, structural and environmental repairs to the dam and waterway
- Dike mowing

Waterway maintenance

- Installation and maintenance of signs, booms, buoys
- Gate maintenance
- Diagnostic testing
- Penstock maintenance
- Cleaning trash racks and intake valves
- Dike, waterway and penstock inspection, leak repair etc.
- Forebay maintenance
- Sluice gate maintenance
- Intake and waterway inspections
- Underwater inspections

Supervision, technical and non-project engineering support

- Supervision
- All technical and engineering support related to WW&D maintenance

Costs Nonlabor costs include:

- All replacement parts
- Materials used to support the above activities, including consumables
- Outside labs, analysis or leased equipment
- Clothing and safety apparel
- Equipment

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NOTES:

1. Include scheduled and unscheduled maintenance charged to general maintenance accounts but specifically **EXCLUDE** the following:
   - Maintenance associated with a project that was charged to a specific project charge number. Account for this maintenance work under Investment.
2. Account for maintenance on the plant side of the headgate or final valve under Station Maintenance.
3. Account for fleet and boat costs under On-Site Support or Off-Site Support.
4. Account for ice breaking under Operations.

Buildings and Grounds Maintenance

Definition Include all activities associated with maintenance of buildings, facilities and grounds.

Scope All activities listed below, whether performed by company personnel or contractors, operations, maintenance, or support personnel, irrespective of whether these personnel are part of the station's budget.

Activities Activities include:

- General station housekeeping not related to generation or control systems
- Buildings maintenance (painting, repairs, roof leaks, etc.)
- Elevator, drainage, and fire suppression maintenance
- Domestic water system and waste water treatment system maintenance
- Landscaping of grounds EXCEPT dike mowing
- Cleaning and trash removal
- Snow removal
- Road maintenance
- All supervision and engineering support related to this Buildings & Grounds Maintenance

Costs Nonlabor costs include:

- All replacement parts
- Materials used to support the above activities, including consumables
- Outside labs, analysis or leased equipment
- Clothing and safety apparel
- Equipment

! **NOTES:**

1. Include scheduled and unscheduled maintenance charged to general maintenance accounts but specifically **EXCLUDE** the following:
   - Maintenance associated with a project that was charged to a specific project charge number. Account for this maintenance work under Investment.
2. Account for fleet costs under On-Site Support or Off-Site Support.
3. Account for all maintenance associated with parks and recreational facilities under Public Affairs and Regulatory.

Investment

Definition

Projects qualify as investment projects if at least one of the items listed under Project Purpose applies **AND** the projects can be classified as one of the two Project Types listed below. Work that does not meet the Project Purpose and Project Type criteria should be identified as Station Maintenance, Waterways & Dams Maintenance, Buildings & Grounds Maintenance or Public Affairs and Regulatory, as appropriate.

Project Purpose
All projects undertaken to:

- Restore a facility to its original design or operating and maintenance characteristics, OR
- Provide additional capacity, OR
- Improve operating and maintenance characteristics, OR
- Create new fish, environmental, recreational or visitor facilities, OR
- Dealing with new regulatory or relicensing issues that require physical additions to the plant

Project Type
All projects where:

- Work was charged as a specific project account distinct from general blanket accounts **AND**
- Work was maintenance related and was associated with major overhaul work (i.e., a major overhaul is a significant reconditioning of the units designed to return them to their "like new" condition. A major overhaul typically lasts 12 weeks or longer and occurs at cycles longer than 10 years).

Scope

All activities associated with projects, whether performed by company personnel or contractors, operations, maintenance or support personnel AND whose activities are charged to the project.

Illustrative Projects

Generating Equipment

- Transformer replacement (replacement of like for like)
- Major overhauls which restore diminished capacity
- Overhaul generator components
- Breaker replacement
- Overhaul turbine components
- Large scale piping replacement
- Transformer upgrade
- Headgate upgrade
- Runner upgrade
- Upgrade exciters

- Governor upgrade
- Frequency upgrade

Control Systems

- Replace relays panel with solid state relaying
- Replace voltage regulators and relays
- SCADA upgrade
- Station service metering upgrade
- Protection upgrade
- Station automation
- Sequence of events recorder

Waterways and Dams

- Hydraulic pump replacement
- Sluice gate or trash gate replacement
- Penstock replacement
- Replacement/refurbishment of concrete (dams, headwork, intake)
- Replacement of major equipment
- Capacity expansion of penstock
- Gate upgrade
- Hydraulic pump system upgrade

Buildings and Grounds (includes non-technical equipment and facilities in the plant)

- Crane overhaul/replacement
- Roof replacement
- Powerhouse concrete refurbishment
- Crane upgrade
- Upgrade site drainage
- Install new cold storage building
- Add new office wing
- Expansion/upgrade of access roads
- Upgrade entire fire protection system

Public Affairs & Regulatory

- Parks and recreational facility construction
- Fish hatchery construction

- Visitor center construction
- Fish ladder construction

!	**IMPORTANT NOTES:** 1. EXCLUDE scheduled and unscheduled maintenance that is charged to general maintenance accounts. Account for this cost under Station Maintenance. 2. Do not account for projects in the switchyard or transmission system beyond the high side of the GSU or the high side of the GSU breakers.

On-Site Support

Definition All activities associated with support services that are located at the plant.

Scope All activities listed below, whether performed by company personnel or contractors.

Activities Human resources

- Compensation administration
- Benefit administration
- Labor relations
- Employment and employee programs

Fleet services

- Management and utilization of on-site vehicles
- Operating and maintenance costs for all on-site vehicles
- Boat operating and maintenance costs
- Mobile tool and work equipment management

Information services

- Major systems design
- Applications development
- Data communications
- Mainframe operations
- Data security
- Disaster recovery
- Network management and administration
- Management of computer hardware and software

Security

- Personnel access and control
- Vehicle access and control
- Security systems management
- Employee background checks

Purchasing

- Vendor management
- General and technical purchase management

- Materials expediting
- Commercial terms management
- Claims

Materials and stores

- Station materials management not in support of station maintenance
- Inventory management
- Coordination with central warehouse and company materials management system

Safety management

- Maintain and create safety programs
- Monitor and control site safety conditions
- Track safety performance

Budgeting and accounting

- Coordinate and assist in preparing budgets
- Provide budget variance and status information
- Serve as primary interface with company budget information services

Training

- Conduct non-technical company training programs
- Track employee training participation

Other administrative services

- Other support services not specifically identified above

Costs

Nonlabor costs include:

- Operating and maintenance costs for all on-site vehicles
- Materials and supplies

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NOTES:

1. **EXCLUDE** all engineering charges. For the purposes of this program, engineering is not considered an On-Site or Off-Site Support service. Engineering is captured in the other functions -- all engineering personnel and contractors should be allocated to the function it serves (i.e., operations, station maintenance, waterways & dams, buildings & grounds, investment etc.).
2. Account for services that are provided by off-site resources under Off-Site Support.

Off-Site Support

Definition All activities associated with support services provided by personnel who are not based at the station. There are two types of Off-Site Support services:

- Off-Site Support - Direct Bill: For this type of support service, the stations are directly billed for a portion or all of the salaries of the support staff that provides services to the station.
- Off-Site Support - ALLOCATED: Stations are not directly billed for the salaries of support services staff. The stations are, however, indirectly billed for these support services through a corporate accounting allocation process, resulting in an "overhead" support cost that the station must ultimately bear. Usually in this situation, the stations have little control over the support services provided or over how these costs are allocated to the station level.

Scope All activities listed below, whether performed by company personnel or contractors.

Activities Human resources

- Compensation administration
- Benefit administration
- Labor relations
- Employment and employee programs

Fleet services

- Management and utilization of off-site vehicles
- Operating and maintenance costs for all off-site vehicles
- Mobile tool and work equipment management

Information services

- Major systems design
- Applications development
- Data communications
- Mainframe operations
- Data security
- Disaster recovery
- Network management and administration
- Management of computer hardware and software

Security

- Personnel access and control

- Vehicle access and control
- Security systems management
- Employee background checks

Purchasing

- Vendor management
- General and technical purchase management
- Materials expediting
- Commercial terms management
- Claims

Materials and stores

- Station materials management
- Inventory management
- Coordination with central warehouse and company materials management system

Safety staff

- Maintain and create safety programs
- Monitor and control site safety conditions
- Track safety performance

Budgeting and accounting

- Coordinate and assist in preparing budgets
- Provide budget variance and status information
- Cash disbursements and cash receipts

Training staff

- Conduct non-technical company training programs
- Track employee training participation

Legal

- Litigation support
- Disputed claims support

Other administrative services

- Other support services not specifically identified above

Corporate Management

- Corporate management staff costs

Corporate Office Staff/Services

- Corporate office staff costs
- Corporate services costs

Corporate Facilities

- Costs related to the ongoing support of corporate facilities

Costs

Nonlabor costs include:

- Operating and maintenance costs for all off-site vehicles
- Materials and supplies

! **NOTES:**

1. **EXCLUDE all engineering charges.** For the purposes of this program, engineering is not considered an On-Site or Off-Site Support service. Engineering is captured in the other functions -- all engineering personnel and contractors should be allocated to the function it serves (i.e., operations, station maintenance, waterways & dams, buildings & grounds, investment etc.).
2. Account for services that on-site resources provide, and for which the corresponding cost for these services is directly billed to the station, under On-Site Support.

Public Affairs and Regulatory

Definition All activities associated with managing regulatory, environmental, and community issues as well as those activities that are required to maintain the franchise to use the water.

Scope All activities listed below, whether performed by company personnel or contractors, operations, maintenance, or support personnel, irrespective of whether these personnel are part of the station's budget.

Activities Activities include:

- Relicensing
- Public relations
- Operations and maintenance of visitors centers
- Operation and maintenance of parks and recreational facilities
- Real estate management, including leases and other community relations (for PA&R assets)
- Navigation services support
- Operation of fish hatcheries
- Fish and game issues
- Buildings and grounds maintenance associated with parks and recreational facilities

Costs Nonlabor costs include:

- All replacement parts
- Materials used to support the above activities, including consumables
- Outside labs, analysis or leased equipment
- Clothing and safety apparel
- Equipment

! **IMPORTANT NOTES:**

1. Include scheduled and unscheduled maintenance charged to general maintenance accounts for PA&R facilities (visitor's centers, recreational facilities, etc.) but specifically EXCLUDE the following:
   - New construction charges associated with PA&R projects that was charged to a specific project charge number (i.e., new visitors center, fish ladder, etc.). Account for this work under Investment.
2. Account for fleet costs under On-Site or Off-Site Support.

Functions Not Benchmarked

Definition Activities that may be performed by the organizations being benchmarked but are not within the scope of the study.

Scope Only those activities listed below qualify as "Functions Not Benchmarked." All other activities need to be accounted for in one of the other benchmarked functions.

Activities Activities include:

- Transmission line maintenance, construction or switching
- Switchyard maintenance past the high side of the GSU or GSU breaker
- Switchyard relaying other than the sudden pressure relay or differential scheme on the transformer
- Distance protection, transmission line communications, and overcurrent schemes
- Fossil support or employees loaned to fossil plants
- Switching in the switchyard except to obtain station clearance
- System operations
- Customer service, distribution, demand side management
- Projects pertaining to the switchyard or transmission on the high side of the GSU
- Shop and stores support of non-benchmarked activities
- Maintenance of dams used for non-hydropower purposes such as navigation
- Business development

Appendix B Staffing Model Factors

Table 13 lists the Nalcor data used as inputs for the Muskrat Falls staffing model.

Table 13. Key input data for Muskrat Falls

Model Factor	Muskrat Falls
ROC	824 MW
# Units	4
Avg. Station Age (Years)	0
# Dams	2
# Head Gates	12
# Spillway Gates	5
Building Space (Meters^2)	9,542
Multi-skilling (Y/N)	N[10]
% ROC Fully Staffed	100%
Total Station Group FTE (less Support)	80.5

[10] Some of Nalcor's 20-25 occupation types have combined (a form of multi-skilling) to optimize efficiency.

Appendix C Timing of Currently Budgeted FTEs

Table 14 provides a list of all currently budgeted positions and recommended start dates.

Table 14. Timing of currently budgeted FTEs

Function	Description	Nalcor	Subs	Total	Start Date
Operations					
	Manager Operations	1		1.0	Q3 2018
	Supervisor - Operation	1		1.0	Q3 2018
	Lead Hydro Plant Operator	5		5.0	Q4 2018
	Hydro Plant Operator	5		5.0	Q1 2019
	Mgr Generation Engineering	1		1.0	Q3 2018
	Manager Production	1		1.0	Q3 2018
	Site Services Supervisor	1		1.0	Q3 2018
	Area Office Clerk, Contracts Coord	1		1.0	Q3 2018
	Senior Manager - Eng Opns Support	1		1.0	Q4 2018
	Multi-disciplined team	2.5		2.5	Q1 2019
	River Management	1.25		1.3	Q1 2020
	Electrical Contracts		0.5	0.5	Q3 2017
	O&M Water Monitoring costs		3.5	3.5	Q1 2018
	Lubricants & Oil Testing		0.1	0.1	Q2 2019
	Supply of PPE		0.3	0.3	Q3 2018
Total Operations		20.8	4.4	25.1	
Plant Maintenance					
	WEM Muskrat Plant	1		1.0	Q3 2018
	Mechanical Maintenance Supervisor	1		1.0	Q3 2018
	Technical / Electrical Supervisor	1		1.0	Q3 2018
	MMA	1.7		1.7	Q4 2018
	EMA	1.7		1.7	Q4 2018
	Maintenance Planner	1		1.0	Q3 2018
	Control Tech	1.6		1.6	Q4 2018
	Engineering Maintenance Support	3.6		3.6	Q4 2018

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Function	Description	Nalcor	Subs	Total	Start Date
	Diesel Generators		0.0	0.0	Q4/2 2017/2020
	Fire panels, alarms, suppression		0.2	0.2	Q4 2017
	Crane and Hoist		5.1	5.1	Q2 2018
	Pressure vessels		0.03	0.03	Q2/3 2018/2010
Total Plant Maintenance		12.6	5.3	17.9	
Waterways & Dams Maintenance					
	MMA, EMA, Control Tech, Genl Maint B	1.5		1.5	Q3 2018
	Trash Removal		0.03	0.03	Q4 2017
	Dams and Dykes		0.9	0.9	Q2 2020
	Debris management on log boom		10.4	10.4	Q3 2019
	North Spur		1.0	1.0	Q3 2019
	ROV - log boom system		0.8	0.8	Q2 2019
	North Spur - instrumentation maint.		0.3	0.3	Q2 2019
	Spillway - claw machine maintenance		0.4	0.4	Q2 2019
Total Waterways & Dams		1.5	13.9	15.4	
Buildings & Grounds Maintenance					
	General Maintenance B	1.5		1.5	Q2 2019
	Snow clearing		3.3	3.3	Q4 2017
	Janitorial		3.3	3.3	Q4 2017
	Road maint. (access roads to sites)		1.1	1.1	Q2 2018
	Pest control		0.1	0.1	Q2 2018
	HVAC (Heating, Ventilation, Air Conditioning)		1.1	1.1	Q1 2018
	Overhead doors		0.5	0.5	Q2 2020
	Vegetation management (spray, cutting, etc.)		0.1	0.1	Q2 2020
	Elevator		0.4	0.4	Q4 2018
Total Buildings & Grounds		1.5	10.0	11.5	
Investment					
	Engineering maintenance support	3.6		3.6	Q2 2019
Total Investment		3.6	0	3.6	
Support					
Accounting/budgeting					
	Tax, treasury, risk & insurance, etc.	5		5.0	Q1 2019

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Function	Description	Nalcor	Subs	Total	Start Date
Corporate management, office staff, & services					
	VP - Production	0.75		0.8	Q3 2018
	VP Engineering Services	0.75		0.8	Q3 2018
Fleet services		0.25		0.3	Q1 2019
Human resources		2		2.0	Q3 2018
Information services		1.5		1.5	Q3 2018
Legal		0.5		0.5	Q1 2019
Materials/warehouse					
	Manager, Business Services; Team lead Planning & Warehousing	0.75		0.8	Q3 2018
Purchasing					
	Contracts Coordinator	1		1.0	Q4 2018
	Buyer, purchasing clerk	3		3.0	Q4 2018
Training & safety					
	HSE Coordinator	0.5		0.5	Q3 2018
	Manager, Safety & Health; Safety Lead	0.75		0.8	Q3 2018
	Training Coordinator	0.1		0.1	Q3 2018
Other					
	Comms and Security (cards, cameras, etc.)		0.4	0.4	Q1 2018
	Site staffed security		2.7	2.7	Q2 2018
	Trucking/transportation		0.3	0.3	Q2 2018
	Maint. mobile equipment		1.9	1.9	Q2 2019
	Inventory Storage and Control		1.5	1.5	Q4 2017
	Tools		0.1	0.1	Q3 2018
Total Support		16.9	6.8	23.7	
Public Affairs & Regulatory					
	Environmental Specialist	1		1.0	Q3 2018
	HSE Coordinator	0.5		0.5	Q3 2018
	ESD Manager	0.5		0.5	Q3 2018
	Environmental Advisor	0.25		0.3	Q3 2018
	Comms Dept members	1.5		1.5	Q3 2018
	Environment Contracts		10.0		Q4 2019

NAVIGANT

Muskrat Falls Staffing Plan

Function	Description	Nalcor	Subs	Total	Start Date
				10.0	
Total PA&R		3.8	10.0	13.8	
Grand Total					
		60.6	50.3	110.9	