

1 Q. Item 16 of the Application states that the turbine valves are critical to the unit operation. Please
2 discuss the importance of the valves from both a production perspective and a safety
3 perspective.

4 A. The Holyrood Thermal Generating Station (“Holyrood TGS”) Unit 2 steam turbine was provided
5 by General Electric complete with a set of steam valves. The major valves, which are included in
6 the scope of this project, are the main stop valve, the six control valves, the two combined
7 reheat stop/intercept valves, the seven extraction steam non-return valves, and the blowdown
8 valve. These valves control the admission of steam energy into the turbine to control the
9 production of electricity and also provide protection to the turbine during upset situations, such
10 as a unit trip, powerline trip, or generator fault that could otherwise cause a catastrophic
11 turbine overspeed condition or other damage to the turbine components.

12 The turbine consists of three steam sections: high pressure, intermediate pressure and low
13 pressure. Each section contains stages of buckets (attached to the rotor) and diaphragms
14 (stationary). Passage of steam through these buckets and diaphragms converts the energy of the
15 steam into rotational energy in the turbine. Steam is admitted from the boiler into the high
16 pressure section of the turbine through the control valves. These valves work together via
17 hydraulic controls; opening as required to admit the quantity of steam necessary to generate
18 the desired megawatt output from the generator. Upstream of the control valves is the main
19 stop valve. All main steam from the boiler passes through this valve and it is designed to slam
20 shut in the event of a trip to stop the supply of steam to the high pressure section of the
21 turbine. Steam is also admitted from the boiler reheater to the intermediate section of the
22 turbine. The admission of this steam is controlled by the combined reheat intercept/stop valves.
23 These valves are opened also by the hydraulic control system and help to control the speed of
24 the turbine as well as the output of the generator. They are also designed to slam shut and seal
25 off steam supply in the event of a trip. The blowdown valve remains closed during normal
26 turbine operation but is required to slam open in the event of a trip to release steam that
27 becomes trapped in the turbine between the closed stop valves on the high pressure and
28 intermediate pressure sections. The extraction non-return valves are also designed to slam shut
29 in the event of a trip. During normal operation these valves allow steam to be extracted from

1 various sections of the turbine to be used for pre-heating of boiler feedwater for efficiency
2 gains. In the event of a trip they must close to prevent backflow of steam into the turbine that
3 could lead to overspeed.

4 Proper operation of all of these valves is required to admit steam to the turbine and control the
5 turbine to produce electricity. Any failure will limit production and most likely result in a forced
6 outage. Due to the complexity and magnitude of the components, significant outages would be
7 expected if repairs were required. For example, a control valve camshaft failure in 2019 resulted
8 in a forced outage of 22 days.

9 From a safety perspective, the stop valves, blowdown valve, and non-return valves must
10 function properly during an operational upset condition to prevent overspeed of the turbine and
11 generator rotor. Overspeed can happen very quickly and these valves must slam shut (or open in
12 the case of the blowdown valve). The turbine rotor weighs approximately 60,000 pounds and
13 rotates at 60 times per second. An overspeed failure has the potential to be catastrophic and
14 provide a serious life-threatening safety risk to plant personnel. Further, the steam admitted to
15 the turbine, even in the intermediate section, is at very high temperatures and high pressures.
16 Failure of any pressure boundary valve component has the potential to become a serious safety
17 hazard.