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ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Duke Energy Carolinas, LLC
Oconee Nuclear Station, Units 1, 2 and 3
Renewed Facility Operating Licenses Numbers DPR-38, DPR-47, and DPR-55
Docket Numbers 50-269, 50-270, and 50-287

Subject: Response to NRC Request for Additional Information Associated with the Measurement Uncertainty Recapture Power Uprate License Amendment Request

References:

1. Duke Energy letter, *License Amendment Request for Measurement Uncertainty Recapture Power Uprate*, dated February 19, 2020 (ADAMS Accession No. ML20050D379)

By letter dated February 19, 2020 (Reference 1), Duke Energy Carolinas, LLC (Duke Energy) submitted a License Amendment Request (LAR) for Oconee Nuclear Station (ONS) Units 1, 2 and 3 to support a measurement uncertainty recapture (MUR) power uprate. The proposed amendment to the Technical Specifications (TS) of Renewed Facility Operating License Nos. DPR-38, 47 and 55 would increase each unit's authorized core power level from 2568 megawatts thermal (MWt) to 2610 MWt; an increase of 42 MWt and approximately 1.64% of Rated Thermal Power (RTP).

By emails dated July 10, 2020 (ML20192A350) and August 4, 2020, the NRC staff notified Duke Energy that additional information is needed for the staff to complete their review. Enclosure 1 to this letter provides the Duke Energy response.

Subsequent to the MUR LAR submittal (Reference 1), Duke Energy reviewed current and expected unit outputs following recent outages that replaced the ONS Units 2 and 3 low pressure turbine rotors and determined that an update to the expected unit outputs following the MUR power uprate is necessary. Updates to LAR Enclosure 2, Sections V.1 and VI.1.A.vii are included in Enclosure 2.

The content of this correspondence does not change the No Significant Hazards Consideration provided in the original submittal (Reference 1).

No regulatory commitments are contained in this letter.

Please refer any questions regarding this submittal to Art Zaremba, Director - Fleet Licensing, at (980) 373-2062.

I declare under penalty of perjury that the foregoing is true and correct. Executed on August 17, 2020.

Very truly yours,

J. Ed Burchfield, Jr.
Vice President
Oconee Nuclear Station

Enclosure 1 Response to NRC Request for Additional Information
Enclosure 2 Revised MUR Power Uprate LAR Information

cc w/enclosures:

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RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

Enclosure 1
(9 pages including cover)

NCSG RAI No. 1:

Section 5.4.2.1, “Steam Generator Materials and Design,” of NUREG-0800, “Standard Review Plan,” provides the NRC staff guidance to review steam generator (SG) designs with respect to potential degradation of the SG tubes. The staff review is focused on maintaining reasonable assurance of SG tube integrity as well as compliance with relevant General Design Criteria (GDC) such as GDCs 14, “Reactor Coolant Pressure Boundary,” and 31, “Fracture Prevention of Reactor Coolant Pressure Boundary.” This includes an evaluation of potential degradation mechanisms that may cause SG tube wear or fatigue of the SG tubes.

Section IV.1.A.vi of the license amendment request (LAR), “Steam generator tubes, secondary side internal support structures, shell, and nozzles,” states that “The MUR [measurement uncertainty recapture] conditions are bounded by the thermal hydraulic conditions used as the design basis for the Replacement Once-Through Steam Generators (ROTSGs).” The thermal hydraulic design parameters for the proposed MUR power uprate conditions are given in Table IV-1, “MUR Power Uprate Critical Parameters,” of the LAR. Updated Final Safety Analysis Report (UFSAR) Table 5-20, “Steam Generator Design Data (Data per Steam Generator),” also provides thermal hydraulic data for the Oconee ROTSGs.

It is unclear whether the thermal hydraulic design data in Table 5-20 of the UFSAR bound the proposed MUR-PU conditions for all parameters. The steam and reactor coolant flows in the UFSAR table appear to be lower than the values provided in the LAR.

Flow through SG tubes and through the tubesheet may impact potential degradation mechanisms of the SG tubes such as fluidelastic instability, vortex shedding, turbulence, tube wear, fatigue, and other flow-induced vibration degradation mechanisms.

Given the apparent discrepancies above, demonstrate that the proposed MUR-PU conditions are bounded by current ROTSG design for flow-induced vibration degradation mechanisms and SG tube wear. If the values are not bounded, explain how SG tube integrity will be maintained at the proposed MUR-PU conditions.

Response

UFSAR Table 5-20, “Steam Generator Design Data (Data per Steam Generator)” includes both “design” and “nominal operating” parameters. The “design” parameters, including the design pressures, design temperatures, hydrotest pressures, volumes and other dimensional data do not change with the proposed MUR power uprate. However, UFSAR Table 5-20 also includes expected operating parameters, including steam flow and steam temperature at full power. The entry for Steam Conditions at Full Load presents the expected operating conditions at the current licensed power level of 2568 MWt. As indicated in LAR Table IV-1, a number of primary and secondary parameters are predicted to change at the MUR power level of 2610 MWt.

The RCS flow value listed in UFSAR Table 5-20 is the Thermal Design Flow (TDF) of 65.66 X 10^6 lbm/hr/steam generator (SG), which is the reactor coolant pump design point shown on UFSAR Figure 5-18 and 5-20. The TDF does not change as a result of the MUR power uprate. The RCS flow shown in LAR Table IV-1 indicates that the expected total RCS flow will increase slightly with MUR from 145.5 X 10^6 lbm/hr to 145.52 X 10^6 lbm/hr. The ONS per steam generator flow change corresponds to 72.75 X 10^6 lbm/hr pre-MUR to 72.76 X 10^6 lbm/hr post MUR. ONS Technical Specification 3.4.1, RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits, refers to the respective Core Operating Limits Report (COLR) for RCS flow requirements. The current COLRs require:

Unit 1 (ML18318A304) - 4 RCP flow ≥ 109.5% design flow

Unit 2 (ML19325E353) - 4 RCP flow ≥ 108.5% design flow

Unit 3 (ML20120A606) – 4 RCP flow ≥ 108.5% design flow

The required COLR RCS flows for MUR do not change.

As noted in the Bases for Technical Specification 3.4.1, a higher RCS flow rate will produce a higher DNBR (Departure from Nucleate Boiling Ratio). Therefore, the limiting flow is Unit 1 at ≥ 109.5% design flow. From the design flow listed in UFSAR Table 5-20:

$$65.66 \text{ X } 10^6 \text{ lbm/hr X } 109.5\% = 71.9 \text{ X } 10^6 \text{ lbm/hr/SG}$$

Meeting the Unit 1 minimum flow bounds the Units 2 and 3 minimum flows.

The pre-MUR operating flow shown in LAR Table IV-1 of 145.5 X 10^6 lbm/hr total or 72.75 X 10^6 lbm/hr/SG exceeds the COLR limit. As discussed in LAR Section IV.1.A.vii and shown in Table IV-1, the post MUR flow will increase slightly due to a small decrease in T-cold and therefore moves in a conservative direction.

UFSAR Table 5-20 will be revised to clarify which parameters are “design” values, and which are “expected operating” values. The expected operating values will be updated to reflect the changes for 2610 MWt.

Davis Besse and Oconee Units 1, 2, and 3 have the same B&W 177 Fuel Assembly (FA) Nuclear Steam Supply System (NSSS) and both have replaced their original steam generators with BWX Technologies, Inc. (BWXT) ROTSGs. The predicted Oconee steam flow at MUR conditions as shown in LAR Table IV-1 is 11.14 X 10^6 lbm/hr. The Davis Besse UFSAR Section 5.2.1.1 (ML18283A907) notes a total steam flow of 11.76 X 10^6 lbm/hr. This comparison of steam flow indicates that Davis Besse operates at a steam flow that bounds the Oconee predicted MUR steam flow. The Davis Besse MUR LAR (ML071030396) evaluation of the Main Steam System (Section VI.1.A.1) concluded that the Davis Besse Main Steam System was not impacted by the MUR power uprate. This conclusion was accepted by the NRC in an SER dated June 30, 2008 (ML081410652). As described in Oconee LAR Section VI.1.A.i, the Main Steam System was reviewed and found acceptable for operation at the MUR power level. One exception was noted for the Cross Around Piping between the high pressure and low pressure turbines being re-rated. This was listed as a Regulatory Commitment in Attachment 1 of the LAR.

LAR Section IV.1.A.vi discusses the structural and seismic analysis of the SGs and concludes that the existing design basis remains bounding for MUR conditions. Section IV.1.A.vi points to Section IV.1.F for further discussion of SG tube degradation mechanisms. Section IV.1.F addresses Flow Induced Vibration, Fluid Elastic Instability, and tube wear. The FIV analysis concludes that the ONS ROTSGs satisfy the acceptance criteria for all potential FIV mechanisms, including fluid-elastic instability, vortex shedding, random turbulence excitation and acoustic resonance at MUR operating conditions. This section concludes that at MUR conditions, the SGs continue to satisfy all original design criteria.

Topical Report BAW-10051, Design of Reactor Internals and Incore Instrument Nozzles for Flow Induced Vibrations, addressed flow induced vibration for fuel assemblies, including fuel rods as well as reactor internals components including incore instrument guide tubes, flow distribution assembly, thermal shield, and inlet baffle. The report is referenced in ONS UFSAR Section 5.2.1.4 and in Davis Besse UFSAR Section 3.9.1.3 (ML18283A901). This Topical remains bounding for ONS at MUR conditions.

Also see below response to EMIB RAI No. 4.

EMIB RAI No. 1

The LAR states that the inservice testing (IST) program does not require revision as a result of Oconee MUR-PU. In a previously submitted Oconee IST document for the fifth 10-year IST program interval (ADAMS Accession No. ML12195A321), the licensee states that the “Code of Record” for Oconee Units 1, 2 and 3 is the ASME Code for Operation and Readiness of Nuclear Power Plants (OM Code), 2004 Edition with 2006 Addenda. Please confirm that the current OM Code of record is the 2004 Edition through the 2006 Addenda for pumps, valves, and snubbers.

Response

As reported in Duke Energy letter to the NRC dated July 2, 2012 (ML12195A321), the fifth 10-year IST interval for ONS began on July 1, 2012. The fifth 10-year interval IST program follows the requirements of the ASME OM Code, 2004 Edition with Addenda through OM-2006. A copy of the ONS Snubber Program (AD-EG-ONS-1618) was transmitted to the NRC, for information, by letter dated October 3, 2019 (ML19276D195). As noted in this submittal, the program was developed to satisfy the snubber preservice and inservice testing and examination requirements of the ASME OM Code, 2004 Edition through 2006 Addenda, and applicable to the fifth 10-year interval for Oconee Nuclear Station, Units 1, 2 and 3.

EMIB RAI No. 2

The LAR does not discuss the evaluation of dynamic restraints/snubbers in support of the proposed MUR-PU. Please describe the snubber evaluation and its results for the proposed Oconee MUR-PU.

Response

Background

ONS snubbers are addressed in Selected Licensee Commitment (SLC) 16.9.18 and are applicable to systems required OPERABLE. As noted, snubbers installed on non-safety systems may be excluded from these SLC requirements provided their failure or the failure of the system on which they are installed would not have an adverse effect on any safety related system.

A copy of the ONS Snubber Program was transmitted to the NRC, for information, by letter dated October 3, 2019 (ML19276D195).

As noted in the Snubber Program Plan, the scope of the program is as described in the ASME Code for Operation and Maintenance of Nuclear Power Plants, 2004 Edition through 2006 Addenda, Subsection ISTA, Article ISTA-1100 and is defined to include the following:

2. Snubber scope for an ASME OM program includes the following:

   a. Snubbers used in systems that perform a specific function in shutting down a reactor to the safe shutdown condition

   b. Snubbers used to maintain the safe shutdown condition

   c. Snubbers employed to mitigate the consequences of an accident

   d. Snubbers used to ensure the integrity of the reactor coolant pressure boundary

3. In keeping with good engineering practice and to provide reasonable assurance of structural reliability, any remaining snubbers not identified above (typically Non-Safety related) may be included in the program and, at a minimum, inspected or monitored periodically.

<u>MUR Systems Review</u>

An MUR engineering study notes that the ONS IST Program, in accordance with the ASME OM Code, includes applicable pumps, valves, and snubbers. The evaluation of ONS's IST Program for an MUR power uprate concluded that the MUR did not affect the current IST Program. The engineering studies for balance of plant (BOP) and nuclear steam supply systems (NSSS) reviews, performed in support of the MUR power uprate assessed the plant systems that are in service, or could be put into service during power operation or design basis accidents. Snubbers were included in these reviews. The assessed systems included those that have snubbers listed in the ONS Snubber Program with one exception. The Steam Generator Flush and Drain System was not reviewed. This system is not in service during power operation, is not an accident mitigation system, and therefore not impacted by an MUR power uprate. All other systems with snubbers within the Snubber Program were found to be acceptable for operation at the MUR power level with no required modifications needed. These results were discussed in the ONS MUR LAR with the additional exception of the steam seal header which does not perform a safety function and is not addressed in the ONS MUR LAR but was reviewed and found acceptable for MUR.

As noted in Section IV.1.E.ii of the ONS MUR LAR, no changes to the IST program are needed as a result of the MUR power uprate. Although this section focuses on pump and valve testing, snubbers are also part of the IST program as discussed in Duke Energy's letter of October 3, 2019 (ML19276D195) that submitted, for information, the current ONS Snubber Program for the fifth 10-year Inservice Testing Program.

ONS Systems with Snubbers

System (Number)	MUR LAR Section	Acceptable for MUR
Main Steam	VI.1.A.i	Yes
Main Feedwater	VI.1.A.iii	Yes
Emergency Feedwater	VI.1.A.iv	Yes
Steam Generator Flush and Drain	N/A	Not operated at power; not accident mitigation
Condensate	VI.1.A.iii	Yes
Condenser Circulating Water	VI.1.C.ii	Yes
Low Pressure Service Water	VI.1.C.iv	Yes
Standby Shutdown Facility	VI.1.C.v	Yes
Reactor Building Purge	VI.1.F.iv	Yes
Steam Seal Header	N/A	Yes
Reactor Coolant	IV.1.A.iv	Yes
High Pressure Injection	IV.1.A.v	Yes
Low Pressure Injection	IV.1.A.v	Yes
RB Spray	VI.1.B.i	Yes
Spent Fuel	VI.1.D	Yes
Pressurizer Relief Discharge	IV.1.A.iv IV.1.A.viii	Yes

EMIB RAI No. 3

The LAR, Table IV-1, "MUR Power Uprate Critical Parameters," shows an increase in reactor coolant and steam flow rate associated with the proposed MUR-PU. The LAR, Section IV.1.A.vi, states that the MUR-PU conditions are bounded by the thermal hydraulic conditions used as the design basis for the ROTSGs. However, the section does not describe an evaluation of the impact on safety-related components due to the increased reactor coolant and steam flow. Please explain how the potential adverse effects (such as flow-induced vibration) on the safety-related components (including pumps, valves, and snubbers) were evaluated for the increased flow associated with the proposed Oconee MUR-PU.

Response

See above response to NCSG RAI No. 1.

Snubbers are addressed in the above response to EMIB RAI No. 2.

EMIB RAI No. 4

The LAR, Section IV.1.B.iii, states that flow-induced vibration concerns are limited to the reactor vessel internals and the steam generator tubes. In light of operating experience related to adverse effects from flow-induced vibration of safety-related components at nuclear power plants, please describe the evaluation of potential vibration effects that could be caused by acoustic resonance created by the increased flow in plant systems from the proposed MUR-PU.

Response

LAR Section IV.1.F addresses Flow Induced Vibration, Fluid Elastic Instability, and tube wear. The FIV analysis concludes that the ONS ROTSGs satisfy the acceptance criteria for all potential FIV mechanisms, including fluid-elastic instability, vortex shedding, random turbulence excitation and acoustic resonance at MUR operating conditions. In addition, an assessment of the MUR on tube wear rates and dynamic sound pressure levels in the ROTSG was performed in 2009. A review of the dynamic pressure transducer and feedwater line accelerometer data from a turbine header pressure test at ONS was performed, and it was concluded that operation at MUR conditions would have an insignificant effect on tube wear and sound pressure levels (acoustic energy) in the ROTSGs. Most of the energy observed in the dynamic pressure transducers is at a very low frequency approximately less than 0.5 Hz. This low frequency scatter was also measured in the plant instrumentation and is indicative of pressure fluctuation in the steam supply system and is not a consequence of acoustic effects. The wavelength of the pressure waves at 0.5 Hz is three orders of magnitude larger than the diameter of a tube such that the resulting pressure gradient across the tube is negligible.

Thermal-hydraulic performance analysis indicates that there is a 2% increase in the mass flow rate for a 2% increase in thermal power with a constant SG nozzle outlet pressure. Combining this increase with an increase in steam mass flow derived from the turbine header pressure test results for a maximum SG outlet pressure of 931 psig (950 psia, total pressure), conservatively nets a mass flow rate increase of 2.75%. The resultant increase in tube vibration response was calculated from instability flow testing and was found to be statistically insignificant.

Also see above response to NCSG RAI No. 1.

<u>EEOB RAI No. 1</u>

The LAR contains the following statements:

"The LEFM CheckPlus ultrasonic flow meter system consists of an electronic cabinet located in the Turbine Building and two measurement sections/spool pieces (each consisting of four electronic transmitters and four pressure transmitters), also located in the Turbine Building."

"Feedwater ultrasonic flow instrumentation is powered from two separate non safety-related power sources from separate power panels. Identical numbers and types of equipment are on each power source and have approximately 5 Amps load. The Panelboards are fed from 208V MCC's which are fed from 112.5KVA transformers. The additional approximate 600VA load on each transformer is less than 0.5% of the transformer rating. The loads are being supplied from presently spare circuit breakers in each Panelboard. This small load addition to each Panelboard has negligible impact and is acceptable."

<u>Please confirm or clarify the following:</u>

- There is one electronic cabinet per unit – three total on site.
- There are two measurement sections per cabinet/unit (One per steam flow header) – six total channels on site. Both measurement sections for each CheckPlus system need to function.
- If one section should fail, the LEFM system for the Unit will be considered non-functional and the Unit will revert to venturi measurements, following the times described in the LAR.
- Each measurement section has four electronic transmitters and four pressure transmitters as described in the first bullet from LAR above.
- Each measurement section is powered by a different non-safety electrical power source as described in the second bullet from LAR above – two for each unit, six separate power sources on site.

  Enclosure 2, Section V of LAR, sub-section DC Distribution, states:

  "The MUR power uprate does not affect the capability or operation of the DC distribution systems. **LEFM equipment installed in support of the MUR power uprate is connected to DC distribution systems and has been determined to be non-significant and within the capacity margins of the system**. All DC systems continue to have adequate capacity and capability for plant operation after the MUR power uprate, and are bounded by the existing analyses and calculations of record for the plant."

  Please clarify the bolded sentence in above paragraph regarding how the LEFM measurement loops are powered.

Response

The NRC request is restated below with Duke Energy's response to each item provided in bold underlined text.

Please confirm or clarify the following:

- There is one electronic cabinet per unit – three total on site.

DE Response - For each unit there are two cabinets mounted back to back on the same frame, each containing a CPU. The CPUs are redundant and receive all pressure transmitter data from the two measurement sections/spool pieces.

- There are two measurement sections per cabinet/unit (One per steam flow header) – six total channels on site. Both measurement sections for each CheckPlus system need to function.

DE Response - There are two measurement sections per unit. Both measurement sections for each CheckPlus system need to function.

- If one section should fail, the LEFM system for the Unit will be considered non-functional and the Unit will revert to venturi measurements, following the times described in the LAR.

DE Response – The description above is correct.

- Each measurement section has four electronic transmitters and four pressure transmitters as described in the first bullet from LAR above.

DE Response - Each measurement section has two electronic transmitters and two pressure transmitters. There are two measurement section/spool pieces per unit.

- Each measurement section is powered by a different non-safety electrical power source as described in the second bullet from LAR above – two for each unit, six separate power sources on site.

DE Response – The description above is correct.

Enclosure 2, Section V of LAR, sub-section DC Distribution, states:

"The MUR power uprate does not affect the capability or operation of the DC distribution systems. **LEFM equipment installed in support of the MUR power uprate is connected to DC distribution systems and has been determined to be non-significant and within the capacity margins of the system**. All DC systems continue to have adequate capacity and capability for plant operation after the MUR power uprate, and are bounded by the existing analyses and calculations of record for the plant."

Please clarify the bolded sentence in above paragraph regarding how the LEFM measurement loops are powered.

DE Response - LAR Enclosure 2, Section V addresses MUR impacts to station electrical systems, including the DC distribution systems. The LEFM equipment is powered from non-safety related AC power sources. The LEFM gateway computer server is powered by non-safety AC regulated power panels that has backup power from the 250VDC Power Distribution System described in UFSAR Section 8.3.2.1.5 and analyzed by Duke Energy. There is no impact to Vital DC Power System as described in UFSAR Section 8.3.2.1.4.

REVISED MUR POWER UPRATE LAR INFORMATION

Enclosure 2
(4 pages including cover)

Revised MUR Power Uprate LAR Information

Starting with the ONS Unit 2 Fall 2019 refueling outage, Duke Energy began replacement of the low pressure steam path in each low pressure (LP) turbine. The LP rotors and associated diaphragms were replaced, thereby restoring the steam flow path to original unit conditions. The turbine vendor predicted that these replacements would recover lost efficiency of the turbine of 3.6 to 5.6 MWe.

Following ONS Unit 2's return to service in late 2019, the performance of the unit with the replacement steam flow path was assessed. In May 2020, a post-modification performance test report was issued. This report showed an increase in the pre-MUR gross generation reported for ONS Unit 2 in the MUR LAR.

The Unit 3 steam flow path (LP rotors and diaphragms) were replaced during the recently completed Spring 2020 refueling outage. The post-modification performance test report is not yet available. The Unit 1 steam flow path (LP rotors and diaphragms) are planned for replacement during a Fall 2020 refueling outage.

Based on the observed increase in Unit 2 and preliminary observation of the Unit 3 post-outage operation, the current and expected unit outputs for the MUR uprate previously reported in the MUR LAR have been updated.

As shown in these updates, assuming the lowest expected condenser inlet temperature, Unit 1 is expected to operate below the generator nameplate rating of 934 MWe; Unit 2 is expected to operate at the generator nameplate rating; and Unit 3 is expected to operate slightly above the generator nameplate rating. This condition was found to be acceptable since all three units will remain within the capacity curve of the generators.

The components downstream of the generator were assessed for the revised generator outputs and no impacts identified. As discussed in LAR Enclosure 2, Section VI.1.C.vii, the Isolated Phase Bus (IPB) cooling is not capable of providing necessary cooling during periods of elevated outdoor temperature. This condition requires that Duke Energy monitor the IPB temperatures and either provide supplemental cooling or limit the maximum thermal power. As currently noted, Duke Energy plans to upgrade the IPB cooling capacity to eliminate this issue. Section VI.1.C.vii was not revised.

The following information supersedes what was previously provided, with changes noted in bold italic text.

V.1 A discussion of the effect of the power uprate on electrical equipment. For equipment that is bounded by the existing analyses of record, the discussion should cover the type of confirmatory information identified under Section II, above. For equipment that is not bounded by existing analyses of record, a detailed discussion should be included to identify and evaluate the changes related to the power uprate. Specifically, this discussion should address the following items:

RESPONSE:

All electrical systems at ONS were reviewed. Below is a brief summary of each electrical system. Specific RIS questions are then addressed separately.

The Main Power System

The Main Power System for each unit includes the generator, voltage regulator, isolated phase buses, main step-up transformer and unit auxiliary transformer. The Main Power System generates power, transmits it to the transmission system, and supplies auxiliary power for normal plant operation. The Main Power System continues to have adequate capacity and capability for plant operation with an MUR power uprate, and is bounded by the existing analysis and calculations of record for the plant.

Main Generator

The rating for each unit's main generator is:

* Units 1, 2, 3 - 934 MWe, 1037.937 MVA, 452 MVAR, 0.9 pf

Pre-MUR operating generator output for each unit is:

* Unit 1 - ***909*** MWe, 1023 MVA, ***470*** MVAR, ***0.889*** pf

* Unit 2 - ***919*** MWe, ***1029*** MVA, ***463*** MVAR, ***0.893*** pf

* Unit 3 - ***922*** MWe, ***1031*** MVA, ***461*** MVAR, ***0.894*** pf

The expected output for the MUR power uprate for each unit is as follows:

* Unit 1 – ***922.7*** MWe, ***1031.3*** MVA, ***460.6*** MVAR, ***0.895*** pf

* Unit 2 – ***932.6*** MWe, ***1037.0*** MVA, ***453.5*** MVAR, ***0.899*** pf

* Unit 3 **–** ***936.2*** MWe, ***1037.9*** MVA, ***448.1*** MVAR, ***0.902*** pf

The Main Generator rating is adequate for the current unit outputs and will continue to be adequate for the MUR power uprated output. The increases in MWe will result in modest reduction in reactive power. ***The Main Generator output will remain within the capacity curve of the generators. The Main Generator reactive capability curve illustrates that the Main Generator is capable of operating at a maximum real power output of 1038 MWe at a 1.0 power factor. It is expected that gross generator output levels will be less than this maximum. Machine operation at a lower real output power level and power factor is permissible provided unit operation remains within the real and reactive power limits defined by the generator reactive capability curve. Maximum MUR gross generator output is expected to be less than 940 MW, which corresponds to a maximum MVAR output of more than 430 MVAR according to the generator capability curve. The generator capability curve is contained within ONS operating procedures.***

Main Step-Up Transformer (MSU)

Units 1 and 2 MSUs are rated at 1000/1120 MVA at 55°C/65°C, 18.1 **/** 230kV, 3-phase. The Unit 3 MSU is made up of 3 single-phase transformers; each rated 373.333 MVA at 65°C rise, 18.05 **/** 525kV.

Each MSU receives power from its associated Main Generator and transmits the power to the switchyard. ***With the Unit 1 Main Generator operating at MUR power uprate conditions, the associated MSU will be loaded to 984.892 MVA. Similarly, with the Units 2 and 3 Main Generators operating at MUR power uprate conditions, their respective MSUs will be loaded to 991.195 MVA.*** In each case, the load is less than the rating of the MSU.

VI.1.A.ii Main Turbine-Generator:

As discussed in UFSAR Section 10.2, the turbine-generator converts the thermal energy of steam produced in the steam generator into mechanical shaft power and then into electrical energy. The turbine-generator consists of a tandem (single shaft) arrangement of a double flow, high pressure turbine and three identical double-flow low pressure turbines driving a direct-coupled generator at 1800 rpm.

The main electrical generators were reviewed at each of the ONS units and it was determined that the electrical generators are acceptable for the MUR power uprate. The increase of MWe due to the MUR power uprate can be accommodated within the present generator **capacity curve** and will result in modest reduction in available reactive power output. A summary of the generator design parameters compared to the actual/available MW/MVAR loading before and after the MUR power uprate is given below in Table VI.1-2. The electrical generators are therefore acceptable for the MUR power uprate.

Table VI.1-1: Generator Design Parameters

	ONS Unit 1		**ONS Unit 2**		**ONS Unit 3**	
Turbine nameplate rating: 1037.937 MVA, 0.90 PF						
Equivalent nameplate rating	MW	MVAR	MW	MVAR	MW	MVAR
	934	452	934	452	934	452
Pre-MUR Values	***909***	***470***	***919***	***463***	***922***	***461***
Post-MUR values	***922.7***	***460.6***	***932.6***	***453.5***	***936.2***	***448.1***

The turbine-generator was reviewed and found to be acceptable for the MUR power uprate level and the unit design rating of 1038 MVA.