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Attachment 4 Contains Proprietary Information. Withhold from Public Disclosure Under 10 CFR 2.390(a)(4). When separated from Attachment 4, this cover letter is decontrolled.

RS-10-131

10 CFR 50.90

September 23, 2010

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

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket No. 50-461

Subject: License Amendment Request to Revise Technical Specifications Limiting Condition for Operation 3.7.6, "Main Turbine Bypass System"

In accordance with 10 CFR 50.90, Application for amendment of license, construction permit, or early site permit, Exelon Generation Company, LLC (EGC) requests an amendment to Facility Operating License No. NPF-62 for Clinton Power Station, Unit 1 (CPS). The proposed amendment would modify the CPS Technical Specifications (TS) Limiting Condition for Operation (LCO) 3.7.6, "Main Turbine Bypass System," by allowing revision of the reactor operational limits, as specified in the CPS Core Operating Limits Report (COLR), to compensate for the inoperability of the Main Turbine Bypass System (MTBS). The revised TS will require that either the MTBS be OPERABLE or that the reactor power, Minimum Critical Power Ratio (MCPR), and Linear Heat Generation Rate (LHGR) limits for an inoperable MTBS be placed in effect as specified in the COLR. Additionally, EGC proposes modifying TS 5.6.5, "Core Operating Limits Report (COLR)," to add a requirement to establish cycle dependent reactor thermal power limits for an inoperable MTBS.

This request is subdivided as follows.

- Attachment 1 provides an evaluation of the proposed change, which includes the technical evaluation, regulatory evaluation, and environmental considerations.
- Attachment 2 provides the existing CPS TS pages marked up to show the proposed changes.
- Attachment 3 provides the proposed CPS TS Bases changes. The TS Bases pages are provided for information only and do not require NRC approval.
- Attachment 4 documents the analysis that was performed to support the proposed change. Attachment 4 contains proprietary information and includes an affidavit attesting to the proprietary nature of the information contained in the document.
- Attachment 5 is a non-proprietary version of the analysis documented in Attachment 4.

Attachment 4 Contains Proprietary Information. Withhold from Public Disclosure Under 10 CFR 2.390(a)(4). When separated from Attachment 4, this cover letter is decontrolled.

The proposed change has been reviewed by the CPS Plant Operations Review Committee and approved by the Nuclear Safety Review Board in accordance with the requirements of the EGC Quality Assurance Program.

EGC requests approval of the proposed license amendment by September 23, 2011. Once approved, the amendment will be implemented within 60 days. This implementation period will provide adequate time for the affected station documents to be revised using the appropriate change control mechanisms.

In accordance with 10 CFR 50.91, Notice for public comment; State consultation, paragraph (b), EGC is notifying the State of Illinois of this application for license amendment by transmitting a copy of this letter and its attachments to the designated State Official.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Mr. Mitchel A. Mathews at (630) 657-2819.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 23rd day of September 2010.

Respectfully,

Jeffrey L. Hansen
Manager – Licensing and Regulatory Affairs

Attachments:

1. Evaluation of Proposed Change
2. Markup of Technical Specifications Pages
3. Markup of Technical Specifications Bases Pages
4. GE Hitachi Nuclear Energy, 0000-0086-4634-R2-P, "Clinton Power Station One Bypass Out of Service or Turbine Bypass System Out of Service Analysis – Final," dated July 2010
5. GE Hitachi Nuclear Energy, 0000-0086-4634-R2-NP, "Clinton Power Station One Bypass Out of Service or Turbine Bypass System Out of Service Analysis – Final," dated July 2010

SUBJECT: License Amendment Request to Revise Technical Specifications Limiting Condition for Operation 3.7.6, "Main Turbine Bypass System"

1.0 SUMMARY DESCRIPTION

This evaluation supports a request to amend Facility Operating License No. NPF-62 for Clinton Power Station, Unit 1 (CPS).

In accordance with 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit," Exelon Generation Company, LLC (EGC) requests an amendment to Facility Operating License No. NPF-62 for CPS. The proposed amendment would modify the CPS Technical Specifications (TS) Limiting Condition for Operation (LCO) 3.7.6, "Main Turbine Bypass System," by allowing revision of the reactor operational limits and limiting reactor power, as specified in the CPS Core Operating Limits Report (COLR). The purpose of these limitations is to compensate for the potential inoperability of the Main Turbine Bypass System (MTBS). The revised TS will require that either the MTBS be OPERABLE or that the reactor power, Minimum Critical Power Ratio (MCPR), and Linear Heat Generation Rate (LHGR) limits for an inoperable MTBS be placed in effect as specified in the COLR.

2.0 DETAILED DESCRIPTION

The MTBS is designed to control steam pressure when reactor steam generation exceeds turbine requirements such as during startup (pressure, speed ramping and synchronizing), sudden load reduction, and cooldown.

The MTBS allows excess steam flow from the reactor to the condenser without going through the turbine. The bypass capacity of the system is 28.8% of Nuclear Steam Supply System (NSSS) rated steam flow; sudden load reductions of up to the capacity of the steam bypass can be accommodated without reactor scram. The MTBS consists of two valve chests, and each chest contains three bypass valves. The valve chests are connected to the main steam lines between the main steam isolation valves and the turbine stop valves. Each of the bypass valves is sequentially operated by hydraulic cylinders. The bypass valves are controlled by the pressure regulation function of the Turbine Electro Hydraulic Control System, as discussed in the CPS Updated Safety Analysis Report (USAR), Section 7.7.1.5.

Normally, the bypass valves are held closed and the pressure regulator controls the turbine control valves (TCVs), directing all steam flow to the turbine. If the speed governor or the load limiter restricts steam flow to the turbine, the regulator controls system pressure by opening the bypass valves. When the bypass valves open, the steam flows from the bypass chests, through connecting piping, to the main condenser. If the capacity of the bypass valves is exceeded while the turbine cannot accept an increase in steam flow, the system pressure will rise and reactor protection system action will cause shutdown of the reactor.

The bypass valves are an automatically-operated, regulating type which are proportionally controlled by the turbine pressure regulator and control system.

The turbine control system provides a signal to the bypass valves corresponding to the error between the turbine control valve opening required by the controlling pressure regulator and the turbine control valve position demanded by the output of the low value gate circuit. An

adjustable bias signal is provided to maintain the bypass valves closed for momentary differences during normal operational transients.

Bypass valves and controls are designed so that bypass steam flow is shut off upon loss of control system electric power or hydraulic pressure.

The current LCO of CPS TS Section 3.7.6, "Main Turbine Bypass System," states:

> The Main Turbine Bypass System shall be OPERABLE.

This requirement is applicable any time thermal power is ≥ 21.6% Rated Thermal Power (RTP). The proposed change would modify the LCO to add an OR statement which would incorporate additional provisions that would allow the alternative of taking the applicable penalties as specified in the COLR when the MTBS is inoperable. This change would add:

> OR
>
> The following limits are made applicable:
>
> a. Reactor THERMAL POWER limit for an inoperable Main Turbine Bypass System as specified in the COLR; and
>
> b. LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)," limit for an inoperable Main Turbine Bypass System as specified in the COLR; and
>
> c. LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)," limit for an inoperable Main Turbine Bypass System as specified in the COLR.

Condition A of the LCO currently states that the MTBS is inoperable. The proposed change to Condition A would be to state that the Requirements of the LCO are not met as follows:

> A. Requirements of the LCO not met.

Required Action A.1 currently requires restoration of the MTBS to an OPERABLE status within two hours whenever the MTBS is inoperable. The proposed change to Required Action A.1 would be to require satisfaction of the requirements of the LCO within two hours as follows:

> A.1 Satisfy the requirements of the LCO.

No changes are being proposed to Required Action B.1. Required Action B.1 will continue to require a reduction in thermal power to be less than 21.6 % RTP in 4 hours.

In addition, the proposed change would revise TS Section 5.6.5, "Core Operating Limits Report (COLR)," by requiring the establishment of a sixth core operating limit prior to each reload cycle in 5.6.5.a as follows:

6. LCO 3.7.6, Main Turbine Bypass System, (cycle dependent thermal power limits for an inoperable Main Turbine Bypass System).

The proposed change to the LCO allows the imposition of reactor power, MCPR, and LHGR operating penalties in lieu of an OPERABLE MTBS to ensure adequate margin to fuel thermal limits. The penalties will be calculated using approved analytical methods, and will be documented in the CPS COLR in accordance with TS Section 5.6.5, "CORE OPERATING LIMITS REPORT (COLR)." The proposed change is consistent with NUREG-1434, "Standard Technical Specifications General Electric Plants, BWR/6 (i.e., Reference 1)." While Average Planar Linear Heat Generation Rate (APLHGR) is used as part of emergency core cooling system (ECCS) and loss of coolant accident (LOCA) bases protection, LHGR limits ensure that anticipated operational occurrences (AOOs) meet the required specified acceptable fuel design limits (SAFDLs). The MTBS out-of-service only affects the AOO bases for the CPS core; therefore, only the LHGR limit is required for protection. Consequently, a LHGR penalty has been added in lieu of the APLHGR penalty in Reference 1 to ensure that the appropriate core operating limits listed in TS 5.6.5 are used.

In summary, this amendment allows revision of reactor operational limits, as will be specified in the CPS COLR to compensate for possible inoperability of the MTBS. The revised TS will require that either the MTBS be OPERABLE or that applicable cycle dependent limits for the inoperable MTBS be placed in effect as specified in the COLR.

3.0 TECHNICAL EVALUATION

The MTBS operates to limit reactor pressure and power increases during a transient. This ensures an adequate margin to protect the MCPR safety limit and the LHGR fuel design limit. This proposed TS change adds requirements to implement a reactor power limitation and more conservative MCPR and LHGR limits if the MTBS becomes inoperable. This change is consistent with Reference 1; however, based on the CPS core design, a reactor power and LHGR has been added in lieu of APLHGR to ensure that the appropriate core operating limits listed in TS 5.6.5 are used.

The fuel designs used at CPS have evolved over time and are more MCPR and LHGR tolerant than earlier designs. This has reduced the need for the MTBS function. Therefore, the development of fuel thermal limits that do not credit the MTBS function will have a minor impact on plant operation over the operating cycle. EGC intends to implement the reactor power limitation and more restrictive core operating limits that do not credit the MTBS function to protect thermal limits at CPS when the function is inoperable. Note that the MTBS function is not being disabled and actuation of this feature, if OPERABLE, will continue to be expected for

any applicable plant event. The effect of MTBS actuation will be to lessen the severity of any plant transient.

The cycle-specific fuel operating limits based on the design function of the MTBS are currently implemented by, and documented in, the CPS COLR. Operating limits for the entire cycle are based on an operable MTBS function. The proposed change will allow the COLR to contain operating limits that are applicable when the MTBS function is not fully OPERABLE. The additional restrictions imposed by the revised set of operating limits and reactor power limitation will offset the impact of losing MTBS functionality. Therefore, no safety consequences are associated with the proposed changes.

Reload analyses are performed each cycle using NRC approved methods documented in TS 5.6.5. Adjustments will be made to the THERMAL POWER, MCPR, and LHGR limits to support operation with an inoperable MTBS. The adjustments will be incorporated into the COLR and into the core monitoring software in the core monitoring computer and plant operating procedures. This will effectively change the initial conditions for the applicable transients. Core damage risk and other risk measures are unaffected by the proposed change since implementation of revised core operating limits provides the equivalent protection for anticipated transients.

The mitigation function of the MTBS is to assure that the fuel design limits are not exceeded. The MCPR is a ratio of the fuel assembly power that results in the onset of boiling transition to the actual fuel assembly power. Operating limits for MCPR are specified to assure that no fuel damage occurs during AOOs.

The LHGR is a measure of the heat generation rate of a fuel rod in a fuel assembly at any axial location. Operating limits for LHGR are specified to assure that the fuel design limits are not exceeded anywhere in the core during AOOs.

Operating limits for MCPR and LHGR along with the reactor power limitation in the COLR will assure that these values remain within accident analyses with the MTBS inoperable. The proposed TS changes avoid a significant power reduction with the MTBS being inoperable, if reactor power is limited within the range specified in the COLR and the MCPR and LHGR limits are within the ranges specified in the COLR. The changes would increase plant operational flexibility.

Attachment 4 documents the analysis that was performed to support the proposed change. Attachment 4 contains proprietary information. A non-proprietary version of the analysis is contained in Attachment 5.

Section 3.0 of the analysis documents the NRC-approved methodology and key inputs that were employed to conduct the analysis. Included in the list of NRC-approved methods in Section 3.1 of the analysis is the boiling water reactor core thermal hydraulics program (i.e., ISCOR). ISCOR is used and approved for all reload licensing applications and is used in power uprate calculations in the same manner that it is used in the MTBS out-of-service calculations. The use of ISCOR is considered approved through the approval of the General Electric Standard Application for Reactor Fuel GESTAR-II as discussed in Section 2.0 of the analysis. Section 4.0 of the analysis documents the CPS-specific transients that were analyzed, and

Section 5.0 documents the analyses results for both rated and off-rated power events. The conclusions that support the proposed change are located in Section 6.0 of the analysis.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

The proposed changes have been evaluated to determine whether applicable regulations and requirements continue to be met.

In Section 50.36, Technical specifications, of Title 10 of the Code of Federal Regulations (10 CFR), the NRC established its regulatory requirements related to the content of TS. In accordance with 10 CFR 50.36, TSs are required to include items in the following five specific categories related to station operation: (1) safety limits, limiting safety system settings, and limiting control settings; (2) LCOs; (3) surveillance requirements (SRs); (4) design features; and (5) administrative controls. The rule does not specify the particular requirements to be included in a plant's TS.

Paragraph 50.36(c)(2)(ii)(C) of 10 CFR specifies that a TS LCO must be established for a structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis event or transient that either assumes the failure or presents a challenge to the integrity of a fission product barrier. Paragraph 10 CFR 50.36(c)(3) specifies that SRs are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components would be maintained within safety limits, and that the LCOs will be met. As required by these two sections of 10 CFR 50.36, an LCO and SRs for the operability of the MTBS are specified in TS 3.7.6 to assure the quality of the MTBS functions. The NRC provides guidance for the implementation of the requirements of 10 CFR 50.36 to General Electric (GE) BWR/6 plants in Reference 1. Since CPS is a GE BWR/6 plant, the use of Reference 1 is appropriate for use as guidance in the review of the proposed TS changes.

Appendix A to 10 CFR Part 50, General Design Criterion (GDC) 10, "Reactor design," requires that the reactor core and associated coolant control, and protection systems be designed with appropriate margins to assure that specified acceptable fuel design limits (SAFDLs) are not exceeded during any conditions of normal operation, including the effects of AOOs. In the application of BWRs, the Safety Limit Critical Power Ratio (SLCPR) is established to assure compliance with SAFDLs. Above the SLCPRs, the fuel rods would not experience a boiling transition during normal operation conditions and AOOs. The LHGR and APLHGR safety limits are the other SAFDLs specified to avoid the fuel design limits from being exceeded. In support of safe plant operations, the MTBS is used to provide consequence mitigation for applicable transients assumed in safety analysis to assure that the thermal limits are not exceeded during normal operation conditions and AOOs. When the MTBS is inoperable, compensation to the operating limits of the MCPR and LHGR and the limitation of reactor power are made for maintaining the margin to the operating limits assumed in the safety analysis.

NRC Generic Letter (GL) 88-16, "Removal of Cycle-Specific Parameter Limits from Technical Specifications," dated October 3, 1988, allows licensees to include the cycle-specific

parameters in the COLR, provided the changes in the parameters are determined using an NRC-approved methodology and consistent with all applicable limits of the analysis of record.

EGC has determined that the proposed changes do not require any exemptions or relief from regulatory requirements, other than the TS, and do not affect conformance with any GDC differently than described in the USAR.

4.2 Precedents

This change is similar to a request made by Entergy for the River Bend Station which was approved for use in a letter from the NRC dated June 24, 2009 (i.e., Reference 2). The Entergy application included an APLHGR limit in addition to MCPR and LHGR limits; however, as discussed in Sections 2.0 and 4.1 above, an APLHGR limit is not necessary to ensure margins to design limits when the MTBS is out-of-service at CPS. Additionally, the NRC approved a change for the PPL Susquehanna Steam Electric Station, Units 1 and 2 (SSES) by letter dated December 3, 2004 (i.e., Reference 3). The change at SSES only included the addition of penalties for LHGR, since the SSES MTBS LCO already included a requirement to apply MCPR limits as specified in the COLR to allow operation above 23% with an inoperable MTBS.

4.3 No Significant Hazards Consideration

In accordance with 10 CFR 50.90, Application for amendment of license, construction permit, or early site permit, Exelon Generation Company, LLC (EGC) requests an amendment to Appendix A, Technical Specifications (TS) of the Clinton Power Station, Unit 1 (CPS), Facility Operating License No. NPF-62. Specifically, the proposed change would modify TS 3.7.6, "Main Turbine Bypass System," and TS 5.6.5, "Core Operating Limits Report (COLR)," for CPS allowing the reactor operating limits to be modified, as specified in the CPS, Core Operating Limits Report (COLR), to compensate for the inoperability of the Main Turbine Bypass System (MTBS). The change will provide an alternative to the existing Limiting Condition for Operation (LCO) for the MTBS. The revised TS will require that either the MTBS be OPERABLE or that reactor power, Minimum Critical Power Ratio (MCPR), and Linear Heat Generation Rate (LHGR) limits for the inoperable MTBS be placed in effect as specified in the COLR.

EGC has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The MTBS functions to limit reactor pressure and power increases during certain transients postulated in the accident analysis. The MTBS is a mitigation function and not the initiator of any evaluated accident or transient. Operation with an inoperable MTBS while in compliance with the imposed reactor power limitation, and MCPR and LHGR limits will offset the impact

of losing the MTBS function. Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed change will not create any new modes of plant or equipment operation. The proposed change allows the option to apply a reactor power penalty and an additional penalty factor to the MCPR and LHGR when the MTBS is inoperable. The imposed reactor power limitation and the revised set of MCPR and LHGR limits will offset the impact of losing the MTBS function, and maintain the margin to the MCPR safety limit and the thermal mechanical design limits. Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

   Response: No.

   By establishing more restrictive reactor power and MCPR and LHGR operating limits, there are no changes to the plant design and safety analysis. There are no changes to the reactor core design instrument setpoints. The margin of safety assumed in the safety analysis is not affected. Applicable regulatory requirements will continue to be met and adequate defense-in-depth will be maintained. Sufficient safety margins will be maintained.

   The analytical methods used to determine the reactor power limitation and the revised core operating limits were reviewed and approved by the NRC and are described in Technical Specification 5.6.5, "Core Operating Limits Report (COLR)."

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, EGC concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of no significant hazards consideration is justified.

4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, "Standards for Protection Against Radiation," or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or a significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. NUREG-1434, "Standard Technical Specifications General Electric Plants, BWR/6," Revision 3, dated June 2004

2. Letter from A. B. Wang (NRC) to Entergy Operations, Inc., "River Bend Station, Unit 1 – Issuance of Amendment Re: Main Turbine Bypass System (TAC No. MD7966)," dated June 24, 2009

3. Letter from R. V. Guzman (NRC) to B. L. Shriver (PP&L), "Susquehanna Steam Electric Station, Units 1 and 2 – Issuance of Amendments Re: Revised Main Turbine System Requirements Technical Specification Change (TAC Nos. MC1596 and MC1597)," dated December 3, 2004

ATTACHMENT 2

Markup of Technical Specifications Pages

3.7-13
5.0-18
TS INSERT

3.7 PLANT SYSTEMS

3.7.6 Main Turbine Bypass System

LCO 3.7.6 The Main Turbine Bypass System shall be OPERABLE.

TS Insert

APPLICABILITY: THERMAL POWER ≥ 21.6% RTP.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ~~Main Turbine Bypass System inoperable.~~ Requirements of the LCO not met.	A.1 ~~Restore Main Turbine Bypass System to OPERABLE status.~~	2 hours Satisfy the requirements of the LCO.
B. Required Action and associated Completion Time not met.	B.1 Reduce THERMAL POWER to < 21.6% RTP.	4 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.6.1	Verify one complete cycle of each main turbine bypass valve.	31 days
SR 3.7.6.2	Perform a system functional test.	24 months
SR 3.7.6.3	Verify the TURBINE BYPASS SYSTEM RESPONSE TIME is within limits.	24 months

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR)

a. Core operating limits shall be established prior to each reload cycle, or prior to any remaining portion of a reload cycle, and shall be documented in the COLR for the following:

1. LCO 3.2.1, Average Planar Linear Heat Generation Rate (APLHGR),

2. LCO 3.2.2, Minimum Critical Power Ratio (MCPR),

3. LCO 3.2.3, Linear Heat Generation Rate (LHGR),

4. LCO 3.3.1.1, RPS Instrumentation (SR 3.3.1.1.14), ~~and~~

5. LCO 3.3.1.3, Oscillation Power Range Monitor (OPRM) Instrumentation, and

6. LCO 3.7.6, Main Turbine Bypass System, (cycle dependent thermal power limits for an inoperable Main Turbine Bypass System).

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC in

(1) General Electric Standard Application for Reactor Fuel (GESTAR), NEDE-24011-P-A, or

(2) NEDO-32465, "BWR Owners' Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications."

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

(continued)

TS INSERT

OR

The following limits are made applicable:

a. Reactor THERMAL POWER limit for an inoperable Main Turbine Bypass System as specified in the COLR; and

b. LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)," limit for an inoperable Main Turbine Bypass System as specified in the COLR; and

c. LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)," limit for an inoperable Main Turbine Bypass System as specified in the COLR.

ATTACHMENT 3

Markup of Technical Specifications Bases Pages

B 3.7-25
B 3.7-26
TS BASES INSERTS

B 3.7 PLANT SYSTEMS

B 3.7.6 Main Turbine Bypass System

BASES

BACKGROUND

The Main Turbine Bypass System is designed to control steam pressure when reactor steam generation exceeds turbine requirements during unit startup, sudden load reduction, and cooldown. It allows excess steam flow from the reactor to the condenser without going through the turbine. The bypass capacity of the system is 28.8% of the Nuclear Steam Supply System rated steam flow. Sudden load reductions within the capacity of the steam bypass can be accommodated without reactor scram. The Main Turbine Bypass System consists of two valve chests (each with three bypass valves) connected to the main steam lines between the main steam isolation valves and the turbine stop valves. Each of the bypass valves is sequentially operated by hydraulic cylinders. The bypass valves are controlled by the pressure regulation function of the Turbine Electro Hydraulic Control System, as discussed in the USAR, Section 7.7.1.5 (Ref. 1). The bypass valves are normally closed, and the pressure regulator controls the turbine control valves, directing all steam flow to the turbine. If the speed governor or the load limiter restricts steam flow to the turbine, the pressure regulator controls the system pressure by opening the bypass valves. When the bypass valves open, the steam flows from the bypass chests, through connecting piping, to the main condenser.

APPLICABLE SAFETY ANALYSES

The Main Turbine Bypass System is assumed to function during the design basis feedwater controller failure, maximum demand event, described in the USAR, Section 15.1.2 (Ref. 2). Opening the bypass valves during the pressurization event mitigates the increase in reactor vessel pressure, which affects the MCPR during the event.

TS Bases Insert A

and LHGR

The Main Turbine Bypass System satisfies Criterion 3 of the NRC Policy Statement.

LCO

The Main Turbine Bypass System is required to be OPERABLE to limit peak pressure in the main steam lines and maintain reactor pressure within acceptable limits during events that cause rapid pressurization, such that the Safety Limit MCPR is not exceeded.

TS Bases Insert B

(continued)

BASES

LCO (continued)

An OPERABLE Main Turbine Bypass System requires the bypass valves to open in response to increasing main steam line pressure. This response is within the assumptions of the applicable analysis (Ref. 2).

TS Bases Insert C

APPLICABILITY

The Main Turbine Bypass System is required to be OPERABLE at ≥ 21.6% RTP to ensure that the fuel cladding integrity Safety Limit and the cladding 1% plastic strain limit are not violated during the feedwater controller failure, maximum demand event. As discussed in the Bases for LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)," and LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)," sufficient margin to these limits exists < 21.6% RTP. Therefore, these requirements are only necessary when operating at or above this power level.

ACTIONS

A.1

If the Main Turbine Bypass System is inoperable (one or more bypass valves inoperable), the assumptions of the design basis transient analysis may not be met. Under such circumstances, prompt action should be taken to restore the Main Turbine Bypass System to OPERABLE status or limit reactor power and apply the MCPR and LHGR limits as specified in the COLR. The 2 hour Completion Time is reasonable, based on the time to complete the Required Action and the low probability of an event occurring during this period requiring the Main Turbine Bypass System.

TS Bases Insert D

B.1

If the Main Turbine Bypass System cannot be restored to OPERABLE status within the associated Completion Time, THERMAL POWER must be reduced to < 21.6% RTP. As discussed in the Applicability section, operation at < 21.6% RTP results in sufficient margin to the required limits, and the Main Turbine Bypass System is not required to protect fuel integrity during the feedwater controller failure, maximum demand event. The 4 hour Completion Time is reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

TS Bases Insert E

(continued)

TS BASES INSERTS

TS Bases Insert A
An inoperable Main Turbine Bypass System may result in reactor power limitations and MCPR and LHGR penalties. An inoperable MTBS is defined as one or more bypass valves being inoperable.

TS Bases Insert B
With an inoperable Main Turbine Bypass System, reactor power may be limited in accordance with the cycle-dependent COLR and modification to MCPR limits (LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)") and LHGR limits (LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)") may be applied in accordance with the cycle-dependent COLR to allow continued operation.

TS Bases Insert C
The reactor power limitations and the MCPR and LHGR limits for an inoperable Main Turbine Bypass System are specified in the COLR.

TS Bases Insert D
and the reactor power limit for an inoperable Main Turbine Bypass System, and the MCPR and LHGR limits for an inoperable Main Turbine Bypass System, as specified in the COLR, are not applied,

TS Bases Insert E
or the reactor power limit for an inoperable Main Turbine Bypass System, as specified in the COLR is not applied, and the MCPR and LHGR limits for an inoperable Main Turbine Bypass System, as specified in the COLR, are not applied within the associated Completion Time,

Attachment 4 Contains Proprietary Information

Withhold from Public Disclosure Under 10 CFR 2.390(a)(4).

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Attachment 4

GE Hitachi Nuclear Energy

GEH Proprietary Information

0000-0086-4634-R2-P

Clinton Power Station One Bypass Out of Service or Turbine Bypass System Out of Service Analysis – Final,

dated July 2010

Attachment 4 Contains Proprietary Information

Withhold from Public Disclosure Under 10 CFR 2.390(a)(4).

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Attachment 5

GE Hitachi Nuclear Energy

Non-Proprietary Information

0000-0086-4634-R2-NP

Clinton Power Station One Bypass Out of Service or Turbine Bypass System Out of Service Analysis – Final,

dated July 2010

HITACHI

GE Hitachi Nuclear Energy

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Class I
July 2010

Non-Proprietary Information

Clinton Power Station

One Bypass Out of Service or Turbine Bypass System Out of Service Analysis - Final

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REVISION SUMMARY

Rev	Required Changes to Achieve Revision
0	NA
1	Created Proprietary version, including affidavit, and Non-Proprietary version for submittal to the USNRC.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

Item	Term	Definition
1	1TBVOOS	One Turbine Bypass Valve Out of Service
2	ADSOOS	Automatic Depressurization System Out-of-Service
3	AOO	Anticipated Operational Occurrence
4	APRM	Average Power Range Monitor
5	BWR	Boiling Water Reactor
6	DLO	Dual Loop Operation
7	EOOS	Equipment Out-of-Service
8	FWCF	Feedwater Controller Failure – Maximum Demand
9	FWTR	Feedwater Temperature Reduction
10	HPCS	High Pressure Core Spray
11	ISCOR	BWR Core Thermal Hydraulics Program
12	ISCOR09	BWR Core Thermal Hydraulics Program, Version 09
13	K(p)	Power Dependent MCPR multiplier
14	LFWH	Loss of Feedwater Heating
15	LHGR	Linear Heat Generation Rate
16	LHGRFAC	Linear Heat Generation Rate Multiplier for Offrated Conditions
17	LHGRFAC(f)	Flow Dependent Linear Heat Generation Rate Multiplier
18	LRNBP	Load Rejection No Bypass
19	MCPR	Minimum Critical Power Ratio
20	MSIV	Main Steam Isolation Valve
21	MSIVD	Main Steam Isolation Valve Closure – Direct Scram
22	MSIVF	Main Steam Isolation Valve Closure – Flux Scram
23	MSIVOOS	Main Steam Isolation Valve Out-of-Service
24	ODYN	One Dimensional Transient Analysis Program
25	ODYNV09	One Dimensional Transient Analysis Program for Recirculation Valve Control Plants
26	OLMCPR	Operating Limit Minimum Critical Power Ratio
27	OOS	Out-of-Service
28	PANAC	Three Dimensional Neutronics Analysis Program
29	PANAC11	Three Dimensional Neutronics Analysis Program, Version 11
30	Pbypass	Power below where Scram is Bypassed for a Turbine Trip/Load Rejection
31	PRFO	Pressure Regulator Failure – Open
32	PROOS	Pressure Regulator Out-of-Service

Item	Term	Definition
33	PWR	Pressurized Water Reactor
34	RCIC	Reactor Core Isolation Cooling
35	RHR	Residual Heat Removal
36	RWE	Rod Withdrawal Error
37	RWL	Rod Withdrawal Limiter
38	SIL	Service Information Letter
39	SLMCPR	Safety Limit Minimum Critical Power Ratio
40	SLO	Single Loop Operation
41	SRVOOS	Safety Relief Valve Out-of-Service
42	TASC	Transient Analysis for Single Channel Program
43	TBSOOS	Turbine Bypass Valves (system) Out-of-Service
44	TCV	Turbine Control Valve
45	TTNBP	Turbine Trip No Bypass
46	UFSAR	Updated Final Safety Analysis Report
47	UO2	Uranium Oxide
48	USNRC	United States Nuclear Regulator Commission
49	w/o	without

1.0 INTRODUCTION

The purpose of this report is to document the evaluation for one turbine bypass valve out of service (1TBVOOS) and the turbine bypass system out of service (TBSOOS). One (1) TBVOOS means that this valve is not credited for fast opening or for normal pressure control. The TBSOOS takes no credit for any bypass flow during an event. The limiting pressurization events are evaluated as well as other potentially limiting events at rated power. Limiting off-rated power transients are also evaluated in this analysis.

The primary limiting event that credits the turbine bypass is the Feedwater Controller Failure (FWCF). Therefore, both a single turbine bypass valve and the turbine bypass system are analyzed out-of-service for this event. Other limiting pressurization events like the Load Rejection and Turbine Trip are already analyzed with no credit for the turbine bypass system.

Other events that involve a power increase and potentially demand the turbine bypass system are also evaluated.

All other non-transient safety analysis aspects are also considered and evaluated in this report. These evaluation conclusions are provided in Appendix B.

2.0 REFERENCES

Item	Reference
1	"Amendment 26 to GE Licensing Topical Report NEDE-24011-P-A, 'GESTAR' – Implementing Improved GE Steady State Methods (TAC No. MA6481)", S. Richards (NRC) to G. Watford (GE), MFN-035-99, November 10, 1999.
2	Licensing Topical Report, "Qualification of the One-Dimensional Core Transient Model (ODYN) for Boiling Water Reactors," NEDO-24154-A, Vols. 1 – 3, February 1986, NEDC-24154P-A Supplement 1, Volume 4, February 2000.
3	"General Electric Standard Application for Reactor Fuel GESTAR-II", NEDE-24011-P-A-16, October 2007.
4	"TASC-03A A Computer Program for Transient Analysis of a Single Channel", NEDC-32084P-A, Revision 2, July 2002

3.0 Methods and Key Inputs

3.1 Methods

The table below summarizes the methods used for the calculations. The application of these methods is within code application capabilities.

Computer Code	Version or Revision	NRC Approved	Comments
PANAC	11	Yes	Reference 1. The physics code PANACEA provides inputs to the transient code ODYN. The use of PANAC Version 11 in this application was initiated following approval of Amendment 26 of GESTAR II by letter from S.A. Richards (NRC) to G.A. Watford (GE), "Amendment 26 to GE Licensing Topical Report NEDE-24011-P-A, GESTAR II Implementing Improved GE Steady-State Methods (TAC NO. MA6481)", November 10, 1999.
ODYN	09	Yes	Reference 2.
ISCOR	09	Yes	Reference 3. The ISCOR code is not approved by name. However, the SER supporting approval of NEDE-24011P Rev. 0 by the May 12, 1978 letter from D. G. Eisenhut (NRC) to R. Gridley (GE) finds the models and methods acceptable, and mentions the use of a digital computer code. The referenced digital computer code is ISCOR. The use of ISCOR to provide core thermal-hydraulic information in reactor internal pressure differences, Transient, ATWS, Stability, and LOCA applications is consistent with the approved models and methods.
TASC	03	Yes	Reference 4.

The GEH methodology for evaluating the potentially limiting Anticipated Operational Occurrences (AOOs) is described in Reference 3. As described in Reference 3, GEMINI methods are used to perform the majority of transient analyses. The USNRC approved codes include PANACEA (GEMINI Physics, Reference 1), ODYN (Reference 2), ISCOR (Reference 3) and TASC (Reference 4). Version 11 of PANACEA code (PANAC11) is used for Core Nuclear Design. Version 9 of the ISCOR code (ISCOR09) is used for calculating reactor core bypass flow behavior as a function of power and flow and hydraulic loss coefficients. The recirculation control valve version of the ODYN code (ODYNV09) is used for the evaluation of the plant transients.

The thermal overpower evaluation is performed in order to demonstrate acceptable margin for both UO2 and Gadolinia fuel rods. The evaluation consisted of Feedwater Controller Failure (FWCF) transients analyzed during the transient analysis evaluations, including equipment out-of-service options. The USNRC approved codes PANACEA (Ref. 1), and ODYN (Ref. 2) are used to perform the evaluation.

3.2 Key Inputs

The key inputs for the analysis are described in Table 3.2-1. The 1TBVOOS and TBSOOS is analyzed to be in combination with Clinton Base Case operation. The Base Case operation is defined as 2 SRVOOS, 1 ADSOOS, 50°F FWTR, 1 MSIVOOS (as long as power is less than 75%) and PROOS. The 2 SRVOOS, 1 MSIVOOS, 1TBVOOS, TBSOOS and the 50°F FWTR are specifically analyzed. The 1 MSIVOOS is restricted to less than 75% power. The ADSOOS relates to small break LOCA analyses, which are not affected by turbine bypass availability. Note 1 TBVOOS/TBSOOS options are not analyzed in combination with a PROOS. The primary issue with PROOS is that a Pressure Regulator failure transient results in a demand to close all control valves with no bypass valve demand. Since bypass valves can not be demanded open in this scenario, no new analysis is required.

Table 3.2-1 Key Inputs

Item	Parameter	Unit	Value
1	EOOS Options	NA	2SRVOOS/1TBVOOS/FWTR 2SRVOOS/1TBVOOS/FWTR/MSIVOOS 2SRVOOS/TBSOOS/FWTR 2SRVOOS/TBSOOS/FWTR/MSIVOOS
2	Turbine Power/Scram Bypass Setpoint	% Rated Power	33.3
3	Thermal Monitoring Threshold	% Rated Power	21.6
4	Turbine Control Valve Capacity	% Rated Power	103

4.0 EVALUATION

4.1 UFSAR Review

The first step in the process is to perform a review of UFSAR transients to determine which transients are potentially affected by a 1TBVOOS or the TBSOOS.

Transient	Discussion
15.1.1 Loss of FW Heater (LFWH)	This is a slow transient where the pressure regulator is credited along with bypass initiation if needed. This event is potentially affected by the lack of bypass capacity. This transient is discussed in Section 4.2, which addresses rated power analyses and the results of the evaluation are provided in Section 5.1.
15.1.2 Feedwater Controller Failure	During the overcooling phase of the FWCF, the increase in subcooling and power increase causes the steam flow to increase. The pressure regulator will regulate the TCVs to pass the increased steam flow and maintain the set pressure at the turbine inlet. A high-level turbine trip occurs due to a level increase to the Level 8 setpoint. Within approximately 0.1 sec after a high level turbine trip the bypass system initiates a fast opening signal. The FWCF is addressed in Section 4.2 for rated power and Section 4.3 for off-rated power. The results for the FWCF are provided in Sections 5.1 and 5.2.
15.1.3 Pressure Regulator Failure Open (PRFO)	The pressure regulator is not a limiting event with respect to MCPR or fuel thermal limits at rated power. The event results in a low steam line pressure followed by an MSIV closure. The MSIV closure results in a non-limiting MCPR event, which results in a scram on MSIV position. With 1TBVOOS or the TBSOOS, [[ ]]
15.1.4 Inadvertent SRV Opening	This event is not limiting with respect to MCPR or fuel duty because the event results in a very small power change. This event does not place an increased demand to the TCVs or turbine bypass system and therefore this event is not affected by 1TBVOOS or the TBSOOS.
15.1.5 Steam Piping Breaks for a PWR	Not Applicable to the Clinton BWR.

Transient	Discussion
15.1.6 Inadvertent RHR Shutdown Cooling Operation	This is a non-limiting event that occurs at power levels near start-up. The event is terminated by a flux scram without any measurable increase in reactor pressure. Therefore the bypass system is not needed for event mitigation.
15.2.1 Pressure Regulator Failure Closed	For the failure of one pressure regulator, the turbine control valves close momentarily. The backup regulator will reopen the control valves with a small perturbation to the system and the bypass is not demanded to open. With a pressure regulator out of service or a pressure regulator downscale failure, the event results in a closure of all of the turbine control valves without the availability of the turbine bypass system. The event is mitigated by high neutron flux or the high-pressure scram. [[ ]]
15.2.2 Generator Load Rejection (with and without bypass)	The more limiting event, load rejection without bypass (LRNBP), is analyzed on a cycle specific basis and bounds the event with bypass available. Since the limiting analysis does not credit the bypass system, the analysis is not affected by 1TBVOOS or the TBSOOS.
15.2.3 Turbine Trip (with or without bypass)	The more limiting event, turbine trip without bypass (TTNBP), is analyzed on a cycle specific basis and bounds the event with bypass available. Since the limiting analysis does not credit the bypass system, the analysis is not affected by 1TBVOOS or the TBSOOS.

Transient	Discussion
15.2.4 MSIV Closure Direct Scram (MSIVD), Single MSIV closure and MSIV Flux Scram	The MSIV closure with a direct scram is a non-limiting event and it is bounded by the reload analyses. [[ ]] The single MSIV closure event results in a high flux scram, high-pressure scram, or a high steam flow isolation (in the open steam lines) followed by a scram from the MSIV position switches. [[ ]] For a complete closure of all MSIVs the bypass system is not demanded as the pressurization occurs upstream of the MSIVs. [[ ]]
15.2.5 Loss of Condenser Vacuum	The loss of condenser vacuum event is similar to a turbine trip with bypass and it is bounded by the turbine trip no bypass. Therefore, the 1TBVOOS and the TBSOOS aspects are bounded by the analysis of the TTNBP.
15.2.6 Loss of AC Power	This event is similar to a load rejection and turbine trip. Therefore, the 1TBVOOS and the TBSOOS aspects are bounded by the analysis of the TTNBP.
15.2.7 Loss of Feedwater Flow	The loss of feedwater flow results in a power decrease followed by a scram on low reactor water level. The reduction in power and scram reduces the demand on the TCVs, and therefore, operation with 1TBVOOS or the TBSOOS does not affect this analysis.
15.2.9 Failure of RHR Shutdown Cooling	This event is a post shut down vessel decay heat removal analysis. The boundary conditions for this event are unchanged with 1TBVOOS or the TBSOOS operation and therefore, this event is not affected.

Transient	Discussion
15.2.10 Loss of Instrument Air	This event is described in the UFSAR as a post scram shutdown-cooling scenario. There is no additional steam load during this event, therefore, operation with 1TBVOOS or the TBSOOS has no impact on this event.
15.3.1 Recirculation Pump Trip	A recirculation pump trip results in a power decrease and is a non-limiting event. [[ ]]
15.3.2 Recirculation Flow Controller Failure Decreasing Flow	A recirculation pump trip results in a power decrease and is a non-limiting event. [[ ]]
15.3.3 Recirculation Pump Seizure	A recirculation pump seizure results in a power decrease and is a non-limiting event compared to other accidents such as the Loss of Coolant accident. [[ ]]
15.3.4 Recirculation Pump Shaft Break	A recirculation pump trip results in a power decrease and is a non-limiting event. [[ ]]
15.4.1 Control Rod Withdrawal Error Low Power	The power level considered for the Rod Withdrawal Error (RWE) at low power are not limiting because the steaming rate at this power level is well within the capacity of the TCV and the bypass system would not be demanded. This event is not affected by 1TBVOOS or the TBSOOS.
15.4.2 Control Rod Withdrawal Error At Power	The RWE at power results in an increase in core average power, but the power increase is limited by the Rod Withdrawal Limiter system. However, the increase in steam flow may not be within the turbine control valve capacity. The RWE is discussed further for the limiting rated power transients in Section 4.2 and the results of the evaluation are presented in Section 5.1.

Transient	Discussion
15.4.3 Control Rod Maloperation	This event is covered by the discussion for 15.4.1 and 15.4.2
15.4.4 Abnormal Startup of an Idle Recirculation Pump	The idle loop startup by definition initiates at an offrated condition, and the pressure regulator is assumed to operate to relieve the increase in steam flow generated by the event. The resulting maximum power and steaming rate (which is below 100% power) is well within the TCV capacity and this event is not affected by 1TBVOOS or the TBSOOS.
15.4.5 Recirculation Flow Controller Failure - Increasing Flow	The limiting analysis presenting in the UFSAR shows that the event results in a high flux scram within seconds of the initiation of the event. The immediate scram reduces steam flow and TCVs are demanded close. There is no additional steam demand placed on the turbine and bypass system. If this event is initiated from lower power levels such that a flux scram setpoint is not exceeded, the capacity of the turbine control valves is capable of passing the steam flow after a flow increase event. Therefore, this event is not affected by 1TBVOOS or the TBSOOS. Flow dependent limits are developed based on a slow recirculation flow increase event. Although this is not a defined UFSAR event, the analysis is performed in a manner to bound the affects of fast flow increase events. The slow recirculation flow increase event is postulated to start from low initial core flow rates and the flow is increased to the maximum core flow runout basis. This results in the largest power and heat flux changes and results in thermal limits that bound the fast flow increase events. With maximum core flow increase starting from the maximum rod line, the core power can exceed the capacity of the bypass system. With a degraded bypass system performance, the resulting transient would be more severe with the lack of capacity. This slow recirculation flow increase analysis is addressed in Section 4.3 and the results are provided in Section 5.2.
15.4.6 Chemical and Volume Control Malfunction	This event is not applicable to the Clinton BWR.
15.4.7 Misplaced Bundle Accident	This is a localized event within the core with the total core power unchanged. This is event is independent of 1TBVOOS or the TBSOOS.

Transient	Discussion
15.4.8 Spectrum of Rod Ejection Assemblies	This event is not applicable to the Clinton BWR.
15.4.9 Control Rod Drop Analysis	The control rod drop accident is not affected by 1TBVOOS or the TBSOOS because this analysis is performed at hot standby or cold shutdown conditions. This event is mitigated by a reactor scram on high flux and the turbine bypass system is not used for mitigation. Therefore, this event is unaffected by 1TBVOOS or TBSOOS.
15.5.1 Inadvertent HPCS/RCIC Pump Startup	These events are non-limiting and do not result in any significant increase demand to the turbine and bypass system. Therefore, these events are not affected by 1TBVOOS or the TBSOOS.
15.5.2 Chemical Volume Control System Malfunction	This event is not applicable to the Clinton BWR.
15.5.3 BWR Transients which Increase Reactor Coolant Inventory	These transients have been addressed in UFSAR section 15.1 and 15.2.
Single TCV Closure	This is not an FSAR defined event, but this event is described in SIL 502 R1. Analyses have been performed for Clinton for a single TCV closure with a scram on high pressure as would occur with no bypass. [[ ]] This limit was determined to be applicable for TBSOOS operation.

Transient	Discussion
Anticipated Transients without Scram	The bypass out of service can make the short term aspect of an event like a load rejection or turbine trip very similar to the limiting events analyzed (e.g. MSIV closure and Pressure Regulator Failure - Open). These events are limiting because the condenser is isolated and only SRVs combined with the Recirculation Pump Trip can mitigate the short-term transient. A load rejection or turbine trip without bypass also isolates the condenser, however, there is additional steam line volume compared to the MSIV closure events. For Clinton, a [[ ]] The long-term behavior of events without bypass is similar to the limiting isolation events (MSIV closure and Pressure Regulator Failure – Open).

4.2 Rated Power Transients

As described in Section 4.1, the key events potentially affected by 1TBVOOS or the TBSOOS at rated power are the FWCF, LFWH and the RWE event. All other events either do not credit the turbine bypass system, or the event is bounded by an event that does not credit the bypass system, or the event is not mitigated by the bypass system. The FWCF was analyzed at rated power for Clinton Power Station Cycle 12 with 1TBVOOS and the TBSOOS. The FWCF is analyzed on a cycle specific basis and operating limits are determined for these two configurations. [[

]]

4.3 Offrated Power Transients

As described in Section 4.1, the key events, potentially affected by 1TBVOOS or the TBSOOS at offrated power, are the FWCF and the slow flow runout of both recirculation pumps. All other events either do not credit the turbine bypass system or the event is bounded by an event that does not credit the bypass system or the turbine control valves have sufficient capacity such that the turbine bypass system is not needed for event mitigation. Both events were analyzed at offrated conditions to assess the impact of the bypass out of service. The analysis results are summarized in Section 5.

5.0 RESULTS

5.1 Rated Power Analyses

Feedwater Controller Failure

The FWCF event was analyzed at rated conditions for Cycle 12 with the allowed EOOS combinations described in Section 3.2. The results of the analyses are provided in Table 5.1-1. The results show a 0.03 OLMCPR increase for the FWCF with 1TBVOOS and a 0.09 OLMCPR increase for the FWCF with the TBSOOS. However, since the Turbine Trip w/o Bypass is more limiting than FWCF, the OLMCPR for 1TBVOOS does not need to increase. The FWCF with the TBSOOS is 0.05 higher than the Turbine Trip w/o Bypass, and therefore, the OLMCPR needs to increase by 0.05 for the TBSOOS condition.

Table 5.1-1 Rated Power Pressurization Results

Limiting results based on limiting conditions, including feedwater temperature reduction **Exposure range: BOC to EOC**		
	Option A Scram Speed OLMCPR	**Option B Scram Speed OLMCPR**
	GE14C	**GE14C**
Turbine Trip w/o Bypass	1.37	1.27
Load Rejection w/o Bypass	1.36	1.26
FW Controller Failure	1.33	1.23
FW Controller Failure with 1TBVOOS	1.36	1.26
FW Controller Failure with the TBSOOS	1.42	1.32

Rod Withdrawal Error

The rod withdrawal error event was evaluated to determine the power increase for the one-foot withdrawal. Above 70% power the RWL system limits the withdrawal to one foot. [[

]] Some small amount of slow pressurization could occur that would increase the steam density and allow for additional capacity, however, it is preferred to avoid pressurization for this event. [[

]]

Loss of Feedwater Heating

The loss of feedwater heating was evaluated to determine the steam flow increase for this event. [[

]] The maximum thermal power achieved for this event is on the order of 117% to 120% thermal power. For the 1TBVOOS condition, there is ample bypass capacity for pressure control for the LFWH event. [[

]] Some small amount of slow pressurization could occur that would increase the steam density and allow for additional capacity. However, it is preferred to avoid pressurization for this event. [[

]] This margin is considered sufficient because the plant would actually scram at a 114% thermal power increase and this would be expected to occur before the steam flow exceeds the turbine control valve capacity.

5.2 Offrated Power Results

Feedwater Controller Failure

FWCF analyses were performed at offrated conditions to assure the existing offrated limits bounded the effects of 1TBVOOS and the TBSOOS operating options. Analyses were performed at 75%, 50%, 33%, and 21.6% of rated power with 1TBVOOS and the TBSOOS. Table 5.2-1 presents the limiting FWCF results in terms of margin the existing K(p) multiplier or the MCPR(p) below the Pbypass power level. The results show large margins to the existing limits. The analyses were relatively insensitive to the MSIVOOS and the more limiting results were with the MSIV in-service.

In each domain, the FWCF transients at all power levels had sufficient margin. Above Pbypass, there was margin between the calculated K(p) and current K(p) limit; below Pbypass, there was also large margin to the generic off-rated MCPR limit below Pbypass. Therefore, the generic power dependent limits continue to apply for 1TBVOOS or the TBSOOS.

Acceptable fuel rod thermal-mechanical performance for both UO_2 and Gadolinia fuel rods was demonstrated at off-rated power with high flow and low flow initial conditions. These analyses also included the effects of 2 SRVOOS, Feedwater Temperature Reduction and the MSIVOOS. The calculated LHGRFAC was well within the currently established limits.

Table 5.2-1: Limiting K(p) and MCPR Values for Each Domain

Power/Flow	Transient	EOOS (a)	K(p)	Current Limit K(p)
75p/107f	FWCF	2SRV + 1TBVOOS	[[	1.125
75p/63.7f	FWCF	2SRV + 1TBVOOS		1.125
50p/107f	FWCF	2SRV + 1TBVOOS		1.288
50p/50f	FWCF	2SRV + 1TBVOOS		1.288
33.3p/107f	FWCF	2SRV + TBSOOS		1.351
33.3p/50f	FWCF	2SRV + TBSOOS	]]	1.351
Below Pbypass				
Power/Flow	**Transient**	**EOOS**	**MCPR**	**Current Limit MCPR**
33.3p/107f	FWCF	2SRV + TBSOOS	[[	2.170
33.3p/50f	FWCF	2SRV + TBSOOS		1.970
21.6p/107f	FWCF	2SRV + TBSOOS		2.460
21.6p/50f	FWCF	2SRV + TBSOOS	]]	2.200

Note (a) TBSOOS = All Turbine Bypass Valves OOS
1TBVOOS = One TBV OOS
2SRV = Two SRV OOS

Slow Recirculation Flow Increase

Flow dependent limits are developed based on a slow recirculation flow increase event. Although this is not a defined UFSAR event, the analysis is performed in a manner to bound the affects of fast flow increase events. The slow recirculation flow increase event is postulated to start from low initial core flow on the MELLLA boundary with normal FW temperature and the flow is increased to the maximum core flow runout basis. [[

]] With 1TBVOOS or the TBSOOS, the flow dependent limits have been determined and are shown in Tables 5.2-2 and 5.2-3.

Table 5.2-2 Flow Dependent MCPR Limit for < 115% Steam Flow Capacity

Core Flow (% Rated)	MCPR(F) DLO (SLMCPR = 1.09)	MCPR(F) SLO (SLMCPR = 1.12)
0	2.04	2.07
25	1.85	1.88
109	1.20	1.23

Table 5.2-3 Flow Dependent LHGRFAC Limit for < 115% Steam Flow Capacity

Core Flow (% Rated)	LHGRFAC(f)
0	0.14
30	0.41
40	0.50
50	0.63
80	0.86
98.3	1
109	1

6.0 CONCLUSIONS

The UFSAR and non-UFSAR analyses bases have been reviewed. The key rated power transients were analyzed. For the FWCF with 1TBVOOS, there was a no impact to the rated power OLMCPR. The TBSOOS, however, does require a 0.05 increase for Cycle 12. The affects of 1TBVOOS and the TBSOOS are analyzed on a cycle specific basis for the FWCF.

Other rated power events (LFWH and RWE) were also evaluated. For 1TBVOOS, there is no thermal limit impact for these events. For the TBSOOS operation, a core power level reduction to less than or equal to [[

]] With this limitation, there is no other effect on the LHGRFAC(P) or MCPR(P) limit.

The minimum acceptable OLMCPR for 1TBVOOS or the TBSOOS [[

]]

The off-rated power analyses demonstrated that none of the FWCF with the TBSOOS results challenge the current limits for Clinton Power Station. There are large margins between the MCPR, K(p), and LHGR for the limiting events and the current limit curves. With this limitation, there is no other effect on the LHGRFAC(P) or MCPR(P) limit. The flow dependent curves are revised to bound the effects of 1TBVOOS or the TBSOOS. There is no effect on MAPLHGR or LHGR SLO multipliers due to one (1) TBVOOS or the TBSOOS.

Appendix A, Recommended Tech Spec Updates

The recommended changes to the Tech Spec LCO 3.7.6 are provided below with the highlighted text:

3.7.6 Main Turbine Bypass System

LCO 3.7.6 The Main Turbine Bypass System shall be OPERABLE.
OR

a. LCO 3.2.2 "Minimum Critical Power Ratio (MCPR)" for an inoperable turbine bypass valve or inoperable Turbine Bypass System, as specified in the COLR and
b. LCO 3.2.3 "Linear Heat Generation Rate (LHGR)" for an inoperable turbine bypass valve or inoperable Turbine Bypass System, as specified in the COLR

APPLICABILITY: THERMAL POWER ≥ 21.6% RTP.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Requirements of the LCO not met.	A.1 Satisfy the requirements of the LCO.	2 hours
B. Required Action and associated Completion Time not met.	B.1 Reduce THERMAL POWER to < 21.6% RTP.	4 hours

The recommended changes to the Tech Spec Bases 3.7.6 are provided below with the highlighted text:

APPLICABLE SAFETY ANALYSES

The Main Turbine Bypass System is assumed to function during the design basis feedwater controller failure, maximum demand event, described in the USAR, Section 15.1.2 (Ref. 2). Opening the bypass valves during the pressurization event mitigates the increase in reactor vessel pressure, which affects the MCPR during the event. An inoperable turbine bypass valve (1TBVOOS) or an inoperable turbine bypass (TBVOOS) system may result in LHGR and MCPR penalties. 1TBVOOS is defined as an inoperable valve that is not credited in the safety analysis. The TBVOOS is defined as the complete system inoperable with no credit for bypass flow.

The Main Turbine Bypass System satisfies Criterion 3 of the NRC Policy Statement.

LCO

The Main Turbine Bypass System is required to be OPERABLE to limit peak pressure in the main steam lines and maintain reactor pressure within acceptable limits during events that cause rapid pressurization, such that the Safety Limit MCPR is not exceeded. With an inoperable turbine bypass valve or an inoperable Turbine Bypass System, modifications to MCPR limits (LCO 3.2.2, "Minimum Critical Power Ratio (MCPR)") and the LHGR limits (LCO 3.2.3, "Linear Heat Generation Rate (LHGR)") may be applied to allow continued operation.

An OPERABLE Main Turbine Bypass System requires the bypass valves to open in response to increasing main steam line pressure. This response is within the assumptions of the applicable analysis (Ref. 2). The MCPR and LHGR limits for an inoperable turbine bypass valve or an inoperable Turbine Bypass System are specified in the COLR.

ACTIONS

A.1

If the Main Turbine Bypass System is inoperable (one or more bypass valves inoperable), or the LHGR and MCPR limits for an inoperable turbine bypass valve or inoperable Turbine Bypass System, as specified in the COLR, are not applied, the assumptions of the design basis transient analysis may not be met. Under such circumstances, prompt action should be taken to restore the Main Turbine Bypass System to OPERABLE status. The 2 hour Completion Time is reasonable, based on the time to complete the Required Action and the low probability of an event occurring during this period requiring the Main Turbine Bypass System.

Appendix B, Additional Assessments for 1TBVOOS and TBSOOS in Clinton Power Station

This appendix documents additional basis for the 1 TBVOOS and the TBSOOS for CPS. These include [[

]]

B.1 Review of [[ ]] for 1TBVOOS and TBSOOS

[[

]]analyses are not impacted by the 1TBVOOS or the TBSOOS option.

B.2 Review of [[ ]] for 1TBVOOS and TBSOOS

[[

]] evaluations are conservative for the 1TBVOOS and the TBS OOS options.

B.3 Review of [[ ]] for 1TBVOOS and TBSOOS

[[

]] analyses are not impacted by the 1TBVOOS or the TBS OOS option.

B.4 Review of [[ ]] for 1TBVOOS and TBSOOS

[[

]] evaluations are conservative for the either OOS option.

B.5 Review of [[ ]] for 1TBVOOS and TBSOOS

[[

]] analyses are not impacted by the 1TBVOOS or the TBSOOS option.

B.6 Review of [[ ]] for 1TBVOOS and TBSOOS

[[

]] analyses are not impacted by the 1TBVOOS or the TBSOOS option.

B.7 Review of [[ ]] for 1TBVOOS and TBSOOS

[[

]] analyses are not impacted by the 1TBVOOS or the TBSOOS option.