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NON-PROPRIETARY

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FitzPatrick MSIV Position Scram Setpoint Change Assessment

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Fitzpatrick MSIV Position Scram Set Point Change Assessment

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Summary

In support of NYPAs proposed change of the MSIV scram trip switches, from 90 to 85% open, evaluations of the impact was made on all affected events and systems. The events were determined by reviewing all Abnormal Operational Occurrences (AOO), listed in the James A. Fitzpatrick (JAF) FSAR.

1.0 Introduction

1.1 Background

New York Power Authority (NYPA) seeks to change the position scram set point, on the MSIVs, from 90% to 85% open. This change will allow easier placement of the trip switches on the MSIVs. Before this change can be implemented, the Technical Specifications need to be changed to reflect this modified scram set point.

The MSIVs, upon demand, are required to close no faster than 3.0 sec. and no slower than 5.0 sec. Changing the MSIV position scram set point from 90% to 85% open, results in a small additional scram delay. This delay is determined by assuming a linear closure rate.

This delay in scram initiation, impacts events that rely on MSIV closure to initiate scram.

1.2 Purpose

It is the purpose of this document to provide the necessary evaluations of Abnormal Operational Occurrences (AOO) and accidents to act as a basis for the proposed Technical Specification changes. In addition, an MSIV hardware review and assessment will be made to assure that components will continue to perform their intended functions.

2.0 Impact on Design and Licensing Bases Evaluations

All of the AOOs and accidents discussed in the James A. Fitzpatrick FSAR (Reference 1) were reviewed in an attempt to identify all events that may be adversely affected by the scram delay inherent with the change to the MSIV position scram trip switches.

2.1 Impact on OLMCPR and Overpressurization Evaluations

Typically, the MSIV direct scram event is a rather mild transient. This event, with the proposed position scram trip switches set at 85% open, was evaluated during the cycle 14 licensing evaluations (note that it was not reported in Reference 2). The results are summarized in Table 2-1 and Figure 2-1a,b,c & d. In addition, both the Load Rejection w/o Bypass and MSIV closure flux scram (assumes that the direct scram fails and scram is initiated on high APRM flux) are also summarized in Table 2-1. Both of these events were originally reported in Reference 2.

Table 2-1
Transient Results Summary

	Peak Value			
Event	Neutron Flux	Heat Flux	Vessel Pressure	Dome Pressure
	(% Initial)	(% Initial)	(psig)	(psig)
MSIV Direct Scram [1]				
Load Rejection w/o Bypass				
MSIV Flux Scram				

Note: 1. The MSIV Direct Scram event was evaluated with the proposed change to the MSIV position scram trip switches (85% open).

Figure 2-1a MSIV Direct Scram (85%)

Figure 2-1b MSIV Direct Scram (85%)

Figure 2-1c MSIV Direct Scram (85%)

Figure 2-1d MSIV Direct Scram (85%)

2.2 Evaluation of Impact on Main Steam Line Break (MSLB)

2.2.1 Impact On Radioactive Material Release

Section 14.6.1.5 of Reference 1 provides the break flow for the MSLB – Outside Containment and Section 14.8.2 provides the resultant radiological consequences. The purpose of this section is to evaluate if the position scram set point change causes a change in the break flow, and if the break flow does change, evaluate the impact on the dose calculations.

The MSLB – Outside Containment analysis conservatively assumes the MSIV closure signal, due to high steam flow, Therefore, the delay in scram will not result in an increase in the mass release for this event.

The assumed activity in the reactor coolant is the Technical Specification maximum activity, which does not change with the delayed scram.

2.2.2 Impact On Peak Clad Temperature

As noted in 2.2.1,

The Fitzpatrick results for the MSLB-outside break show that there is no core uncovery and no cladding heatup occurred (Reference 5).

2.3 Evaluation of Impact on Containment

The containment analysis performed to support licensing activities for FitzPatrick includes events such as Loss-of-Coolant Accident (LOCA), SRV discharge, Alternate Shutdown, Station Black Out (SBO) and the Appendix R (Fire) events. The LOCA events include recirculation and main steam line breaks. The SRV discharge events include stuck-open relief valve, isolation and small break.

This includes containment pressure and temperature, peak suppression pool temperature, containment dynamic loads and SRV dynamic loads.

3.0 Hardware Assessment

3.1 Problems Experienced By NYPA On MSIV Scram Limit Switches

MSIVs installed at the Fitzpatrick site are equipped with three (3) limit switches, the fully open limit switch, the 90 % open limit switch and the fully close limit switch. The 90% open limit switch senses valve closing and provides a half scram signal to the reactor protection system (RPS). When three or more MSIVs in different steam lines are closed over 10% of the valve stroke, the reactor would be scrammed to avoid a pressure surge in the reactor vessel. Thus, the 90% open limit switch is also known as the scram limit switch.

Fitzpatrick did not experience problems with the scram limit switch set up or operation when those limit switches were originally set at a nominally 90% open position. However, the limit switch adjustment was complicated when the utility recognized there is a +/- 3% drift associated with this type of limit switch. In order to assure that the scram limit switch signals the RPS when the valve is partially closed to the 90% open position or below, the scram limit switch has to be set at 93% open. The overall range of position that the scram limit switch may function is between 90% open to 96% open.

The MSIVs are exercised in a valve partially closed test to verify that the MSIV is operable and the scram limit switch will signal the RPS at the proper valve position. If the main disc travel is not reversed before it is too far into the steam flow stream, the steam flow will drag it into the fully closed position. The actuator may not have enough force to overcome the combined fluid drag, differential pressure force, spring force and the dead weight of the main disc. If an MSIV is closed completely when the reactor is operating at full power, the reactor may be scrammed due to high flux or high flow in the main steam lines that remain open.

The fully open limit switch has to be set so it is at a neutral position when the scram limit switch is tripped, and it is also switched when the valve is fully open. Its travel range is limited between 97% open to 100% open. There is only a gap of 1% of the valve stroke to allow the scram limit switch lever arm to reset. Resetting the scram limit switch lever arm is necessary to avoid dual position signals from the fully open limit switch and the scram limit switch. The space limitation is a problem as the total linear travel of the MSIV for setting the two limit switches is between 90% valve open to 100% valve open. If the limit switches are not set at the correct positions, the RPS may not get a "valve partially closed" half scram signal. Additionally, the control room would get either both a "valve partially closed" scram signal and a valve fully open signal simultaneously, or not get a valve fully open signal.

NYPA has experienced frequent problems with getting dual MSIV position signals or not getting a signal of valve fully open at the FitzPatrick site. Setting the scram limit switches and the fully open limit switches became a complicated and time consuming task. The plant operator cannot be sure that the MSIVs are fully open based on limit switch signal alone. The site installed a video camera near some MSIVs, inside a normally inaccessible region of the steam tunnel, to monitor MSIV position.

3.2 Operating BWR Experience With MSIV Limit Switch

GE researched the nuclear reactor industry experience with the MSIVs and the limit switches recorded in the INPO data base. The key words used in the search were MSIV and Limit Switch. The domestic nuclear reactors experienced a large number of MSIV limit switch malfunctions. There are a total of 242 reports related to MSIV limit switch in the INPO data base (Reference 3). Some of the reports are duplicated. Sometimes, multiple reports were generated for different purposes to describe the same incident. The overwhelming majority of the reports are related to the operation of scram limit switches. The types of malfunctions can be categorized as follows:

1. When performing a partial closing test of the MSIV, the scram limit switch did not signal when the valve reached the 90% open position.
2. Control room indicated both the scram function and the fully open function of the MSIV at the same time.
3. MSIV closed completely by the controlling circuit even though the valve was supposed to stop closing and to re-open once the valve reached the 90% open position.

These malfunctions were caused by a variety of factors. One recurring factor is the space limitation at the scram limit switch that was set at 90% open position and the fully open limit switch set point. Other operating BWRS experienced the similar types of problems that NYPA experienced at FitzPatrick. Other causes for the malfunctions documented by INPO are:

1. Improper setting of the scram limit switch lever arm,
2. Mechanical failure inside the limit switch,
3. Lever arms were not properly installed on or torqued to the axis of the limit switch,
4. Lever arm broke during operation,
5. Test procedure did not provide adequate guidelines to reverse MSIV closure in valve partial closing tests,
6. Relay or fuse in the limit switch circuitry burned,
7. Limit switches installation did not match the environmentally qualified (EQ) configuration, and
8. Once the main disc is dragged by the steam flow, the actuator was not strong enough to reverse the closing cycle.

4.0 Conclusions

Changing the MSIV scram trip switches from 90 to 85% open results in the MSIV closure, Direct Scram event having a slight delay in the initiation of scram. This slight delay in scram results in an increase in the energy generated.

5.0 References

1. *Updated Safety Analysis Report,* James A. Fitzpatrick.

2. *Supplemental Reload Licensing Report for James A. Fitzpatrick Reload 13 Cycle 14,* J11-03359SRL Rev. 1, October 1998.

4. INPO data base on MSIV and Limit Switches.

5. *James A. Fitzpatrick Nuclear Power Plant SAFER/GESTR-LOCA Loss of Coolant Accident Analysis,* NEDC-31317P Rev. 2, April 1993.