

## Study of the Allowed Outage Time Extension for the Instrument Bus Inverter

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### 1. Introduction

The current Allowed Outage Time (AOT) for restoration of an inoperable instrument bus inverter is insufficient to support the required maintenance and post-maintenance testing windows from the past experience. This study is proposing the extension of the AOT for the instrument bus inverter from the current 24hours for one instrument bus inverter inoperable to 7days. There are some cases to change the AOT Extension for the instrument bus inverter, for instance, Byron Station and Braidwood Station where AOT for instrument bus inverter was extended from 24hours to 5days.

Implementation of this AOT Extension would provide the following benefits: (1) Allow better control and allocation of resources and allow increased flexibility in the scheduling and performance of preventive maintenance. Allowing on-line preventive maintenance provides the flexibility to focus quality resources on any required or elective instrument bus inverter maintenance; (2) Avert unplanned plant shutdown. Risks incurred by unexpected plant shutdowns can be comparable to and often exceed those associated with continued power operation; and (3) Improve instrument bus inverter availability during shutdown modes or conditions.

### 2. Safety Analysis

#### 2.1 Quantitative Analysis

The risk impact due to extension of the instrument bus inverter AOT was evaluated using Probabilistic Safety Assessment (PSA) model for Ulchin 3,4 which is updated by the project named as "Modification to the AOT/STI in KSNP", (2004.12). With one instrument bus being powered from the Regulating Transformer, the configuration specific Core Damage Frequency (CDF) increase is 1.0E-10/yr level which is judged to be negligible risk increase, and meets the acceptance CDF criteria of < 1.0E-06/yr provided in Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Safety Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis." For a 7-day AOT, an Incremental Conditional Core Damage Probability (ICCDP) is 1.9E-12 which is much less than the ICCDP criteria of 5.0E-07 provided in RG 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications," for TS changes. The quantitative results of the

evaluation are shown in the table below. Therefore, this AOT revision is considered non-risk significant.

Table 1. Results of risk evaluation for Uljin3,4 instrument bus inverter AOT extension

Risk Metric	Risk Significance Criterion	Risk Metric Results
$\Delta CDF_{AVE}$	<1.0E-6/yr	1.0E-10/yr
ICCDP	<5.0E-7	1.9E-12

#### 2.2 Qualitative Analysis

The inverters are the preferred source of power for the AC vital buses because of the stability and reliability they achieved. The function of the inverter is to provide AC electrical power to the vital buses. The inverters can be powered from an internal AC source/rectifier or from the station battery. The station battery provides an uninterruptible power source for the instrumentation and controls for the Reactor Protective System (RPS) and the Engineered Safety Feature Actuation System (ESFAS). The justification for extending AOT for an inoperable instrument bus inverter is based upon deterministic evaluation consisting of main element: the availability of a separate safety-related Regulating Transformer for each instrument bus. This element provides assurance of the capability to provide power to the instrument buses during the instrument bus inverter extended AOT.

### 3. Implementation and Monitoring Program

To ensure the proposed extension of the instrument bus inverter AOT does not degrade operational safety over time, as part of the Maintenance Rule (MR), an evaluation is required if equipment does not meet its performance criteria. Appropriate corrective action should be taken, including a change to the TS if necessary, as required by the MR.

The reliability and availability of the affected instrument bus inverters are monitored under the MR Program. If the pre-established reliability or availability performance criteria are exceeded for the instrument bus inverters, they are considered for 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," paragraph (a)(1) actions, requiring increased management attention and goal setting in order to restore their performance (i.e.,

reliability and availability) to an acceptable level. The performance criteria are risk-based and, therefore, are a means to manage the over time which is precluded by the performance criteria. The instrument bus inverters are all currently in the 10 CFR 50. 65 a(2) MR category (i.e., the instrument bus inverters are meeting established performance goals). Performance of the instrument bus inverter on-line maintenance is not anticipated to result in exceeding the current established MR criteria for instrument bus inverters. The actual instrument bus inverter reliability and availability will be monitored and periodically evaluated to assess the effect of the proposed extended AOT upon plant performance in relationship to the MR goals.

#### **4. Conclusion**

The proposed 7-day instrument bus inverter AOT is based upon both a deterministic evaluation and a risk-informed assessment. The risk assessment concluded that the increase in plant risk is small and consistent with NRC Regulatory Guides 1.174 and 1.177. The deterministic evaluation consisted of main element is the availability of ESF power to the 120V buses and the instrument bus inverter will be monitored as a(2) scope of Maintenance Rule (MR). The evaluation concluded that the proposed changes are consistent with the defense-in-depth philosophy and that sufficient safety margins are maintained. Together these analyses provide high assurance of the capability to provide power to the ESF buses to support instrument bus inverter reliability during the proposed 7-day instrument bus inverter AOT.

The proposed change results in a negligible increase in CDF. The impact of the proposed change will be monitored using performance measures to ensure actual reliability and availability is consistent with the values used in the PSA.

#### **REFERENCES**

- [1] Regulatory Guide 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking Technical Specifications," August 1998.
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- [3] KAERI/TR-1772 Risk-Informed Allowed Outage Time Change for Ulchin Units 3&4, March 2001.
- [4] 'Request for Technical Specification Change Extend the Completion Time for the Instrument Bus Inverters', RS-01-236, Exelon Generation Co., 2002.