

## Application of Risk Managed Technical Specification

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### 1. Introduction

Allowed Outage Time(AOT) was defined as the time for which a safety component can remain inoperable before an plant state is changed, was determined based on deterministic analysis or engineering judgments. Recently, the result of Probabilistic Safety Assessment (PSA) and the operating experiences of nuclear power plants (NPP) show that the AOT can be optimized. From the point of NPP utilities, AOT extension is desired for the avoiding unnecessary shutdown of NPPs and the flexibility of the NPP operation.

In order to provide the necessary operation flexibility during the power operation, the extension of existing AOT is needed. The extension of AOT affects the plant safety. So, overall analysis and evaluation due to the risk changes should be performed. The validity of changed TS requirements should be proved by the assessments. In this paper, we examined the present established AOT methodology, also described the latest methodology of Risk Managed Technical Specification (RMTS) for the purpose of providing reasonable NPP operations.

### 2. Status of the AOT extension

Since the mid-80', utilities in the United States have been applying the risk-informed operation & maintenance based on PSA technology to the NPPs. They successfully operated the NPPs through extensions of AOTs and Surveillance Test Interval(STI)s for safety systems.

The NRC recommended utilities in the U.S. to reasonably improve TS requirements based on the plant risk by NUREG-1366 "Improvements to Technical Specifications Surveillance Requirements" issued in December 1992. In 1998, the staff published the guidance of TS in RG 1.174 "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" and 1.177 "An Approach for Plant-Specific, Risk Informed Decision making : Technical Specification". According to these guidance, Westinghouse Owner's Group(WOG) and CE Owner's Group(CEOG) have performed several studies of AOTs and STIs optimization.

Many NPPs have extended AOTs of Safety Injection Tank(SIT), Low Pressure Safety Injection

(LPSI), Containment Spray System(CSS) and EDG. Lately, RMTS studies for High Pressure Safety Injection(HPSI) system to extend the AOT until 30 days are been lead by utilities.

Table 1. EDGs AOT extension of the U.S. NPPs

Description	D.C Cook		Beaver Valley		Calvert Cliffs		Millstone Unit 2
	Unit 1	Unit 2	Unit 1	Unit 2	Unit 1	Unit 2	
Owner	I&M		FENOC		CCNPP		DNC
NSSS Provider	WH	WH	WH	WH	CE	CE	CE
Application date	SEP. 21, 2004		May 26, 2004		MAY 12, 2003		MAY 31, 2001
Issuance date	SEP. 30, 2005		SEP. 29, 2005		APR. 13, 2004		JAN. 04, 2002
Extension of AOT (days)	3→14	3→14	3→14	3→14	3→14	3→14	3→14

The assessments of AOT extensions for the five systems such as EDG, SIT, LPSI, CSS and HPSI of KSNP were performed by KOPEC. Currently, the official regulating review process is in progress.

### 3. New Concept of Risk Managed Technical Specification Application

The established methodology of AOT extension evaluates risk changes due to TS changes by a deterministic and by a probabilistic method. The results should satisfy the Defense In Depth(DID) concepts, safety margin and the quantitative criteria. Then, evaluate the validity of changed risk due to the extension of AOT should be evaluated.

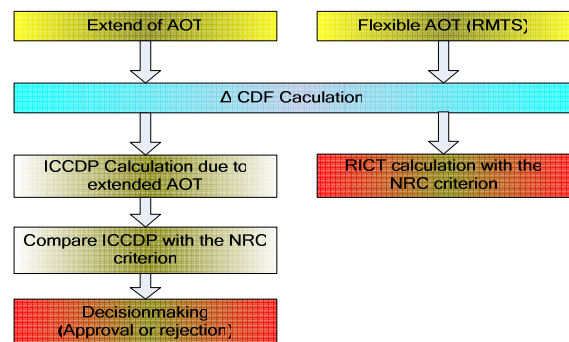


Fig 1. Application process of AOT & RMTS extension

The methodology of RMTS, which is making and managing the permissive Out-of-Service(OOS) time, decides the Completion Time(CT is same as AOT) of

TS as a risk criterion. Risk Managed Action Time(RMAT) means the time to perform the AOT extension action when the calculated risk(ICCDP) meets  $1.0E-6$ . Risk Informed Completion Time(RICT) means finishing the corrective maintenance when the ICCDP meets  $1.0E-5$  or maximum 30 days of maintenance.

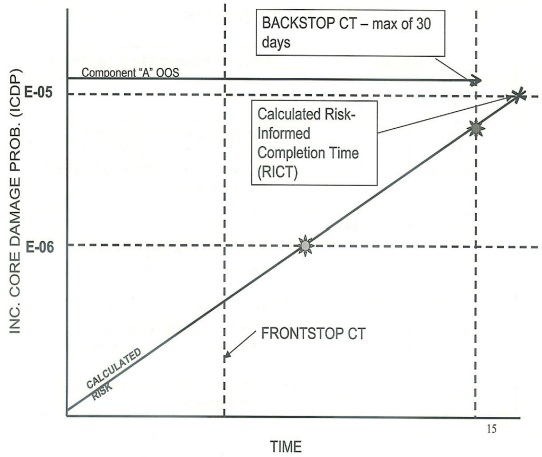


Fig 2. New Concept of Risk Managed Technical Specification extension

Where,

**Completion time(CT)** : Same as Tech. Spec. allowed outage time

**Risk Management Action(RMA)** : action taken to manage or mitigate further risk increase - must be implemented when risk reaches  $1.0E-6$ , but can be implemented earlier

**Risk Management Action Time(RMAT)** : time at which RMAs are required to be implemented when calculated risk  $1.0E-6$  RMTS threshold

**Risk Informed Completion Time(RICT)** :when calculated risk reaches  $1.0E-5$  RMTS threshold-not allowed to exceed 30 days

RMTS risk management thresholds are established quantitatively by considering the magnitude of the risk indicators for the plant configuration

Table 2. Risk Managed Technical Specification Thresholds

Criterion		RMTS Risk Management Guidance
CDF	LERF	
$\geq 10^{-3}$ events/yr	$\geq 10^{-4}$ events/yr	- Voluntary entrance into configuration prohibited-if in configuration due to emergency event, implementation appropriate risk management actions
ICCDP	ICLERP	
$\geq 10^{-5}$	$\geq 10^{-6}$	- Follow the Tech Spec requirements for Required action not met
$\geq 10^{-6}$	$\geq 10^{-7}$	- RMAT and RICT requirements apply - Asses non-quantifiable factors - Implement compensatory risk management actions
$< 10^{-6}$	$< 10^{-7}$	- Normal work controls-no additional Controls required

When the relaxation of technical specifications or regulatory articles for the NPPs in the U.S. is requested, Maintenance Rule and other regulatory articles are applied to those being relaxed as compensatory measures.

A sensitivity analysis was performed. The result shows that RMTS methodology is more flexible for AOT compared to the established AOT methodology. Currently, South Texas Project (STP) NPP who applied for RMTS application is waiting for an approval.

Table 3. A Sensitivity Analysis of AOT Extension

Parameter	Present AOT	RMTS
Current CDF (base)	$5.17E-06$	$5.17E-06$
Current AOT (ITS)	3 Days	3 Days
Proposed CDF (1 EDG OOS)	$1.27E-05$	$1.27E-05$
$\Delta$ CDF	$7.53E-06$	$7.53E-06$
ICCDP (14 Days)	$4.01E-07$	$2.88E-07$
ICCDP (30 Days)	-	$6.19E-07$

#### 4. Conclusion

Risk Managed Tech. Specs(RMTS) is a plant-specific set of configuration-based Tech. Specs, which consider risk impacts over time to determine acceptable Out-of-Service(OOS) times. It is found that RMTS gives more flexibility to the NPP operation, compared to the present AOT extension.

Domestic NPPs also need to extend AOT or RMTS to improve the flexibility on plant operations. Also, the reasonable regulations and the positive attitudes of the regulatory body related to the AOT extensions based on risk informed are needed. Consequently, the AOT extension contributes the NPP performances through decreasing the unexpected plant trips, reinforcing maintenance and avoiding risks due to unnecessary operation mode changes when the NPP is under the surveillance tests or maintenance.

#### REFERENCES

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