Union of Concerned Scientists

Citizens and Scientists for Environmental Solutions

GSI-191: Day 5,123

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Acronym List

BI – barrier integrity
CRDM – control rod drive mechanism
ECCS – emergency core cooling systems
GSI – generic safety issue
IE – initiating event
LOCA – loss of coolant accident
MS – mitigating system
NOED – notice of enforcement discretion
NRC – Nuclear Regulatory Commission
ROP – reactor oversight process
UCS – Union of Concerned Scientists
URI – unresolved item

SECY-10-0113

NRC staff deserves credit for a paper that thoroughly explains the matter, including explanations for non-actions.

Example: UCS planned to advocate removing the in-vessel issue from GSI-191 until reading the staff's rationale on page 7.

GSI-191 Closure Options

Regardless of option(s) chosen, GSI-191 closure will take years

SECY page 4: '...*none of the options below provide an "analysis only" option*...'

Until the non-analytical actions are completed, reactors are operating at elevated risk

GSI-191 Closure Options

NRC staff recommends Options 1.b and 2 for GSI-191 close-out

UCS supports the staff's recommendation with one important caveat – the risks associated with unresolved GSI-191 issues must be formally factored into NRC's regulatory decision-making

GSI-191 Closure Options

The 1.b/2 approach allows the pending 50.46a rulemaking to address the leak before break application issue

UCS finds the NRC staff's evaluation of the worker radiation dose question to be sound and persuasive

GSI-191 Closure Options

UCS agrees with NRC staff that Option 3 is not really a closure option.

In essence, Option 3 says the public is protected from a large break LOCA, unless a large break LOCA occurs.

That's unacceptable public policy.

GSI-191 Reduces Risk

Threat that containment sump screens for ECCS pumps would get clogged by debris during a LOCA is reduced by enlarging screens and reducing amount of potential debris

Until resolved, GSI-191 represents elevated risks

Table 5-7 Results of Parametric Evaluations Regarding Potential for Blockage

ID	SLOCA	MLOCA	LLOCA	ID	SLOCA	MLOCA	LLOCA
1	Likely+	Very Likely+	Very Likely	36	Very Likely+	Very Likely	Very Likely
2	Unlikely	Possible	Very Likely	37	Very Likely	Very Likely	Very Likely
3	Unlikely	Unlikely	Likely	38	Unlikely	Unlikely	Likely
4	Very Likely	Very Likely	Very Likely	39	Unlikely	Possible	Very Likely
5	Very Likely+	Very Likely+	Very Likely	40	Unlikely	Unlikely	Very Likely
6	Likely	Very Likely	Very Likely	41	Unlikely	Unlikely	Likely
7*	Unlikely	Unlikely	Unlikely	42	Likely+	Very Likely	Very Likely
8	Very Likely	Very Likely	Very Likely	43	Unlikely	Unlikely	Very Likely
9	Very Likely	Very Likely	Very Likely	44	Unlikely	Unlikely	Very Likely
10	Very Likely+	Very Likely+	Very Likely	45	Very Likely+	Very Likely+	Very Likely
11	Very Likely+	Very Likely+	Very Likely	46	Unlikely	Possible	Very Likely
12	Possible	Very Likely+	Very Likely	47	Very Likely	Very Likely	Very Likely
13	Unlikely	Unlikely-	Very Likely	48	Very Likely	Very Likely	Very Likely
14	Unlikely	Unlikely	Very Likely	49*	Unlikely	Unlikely	Unlikely
15	Unlikely	Likely	Very Likely	50	Unlikely	Unlikely	Possible
16	Very Likely+	Very Likely+	Very Likely	51	Very Likely+	Very Likely+	Very Likely+
17	Very Likely	Very Likely	Very Likely	52	Unlikely	Unlikely	Likely
18*	Unlikely	Unlikely	Unlikely	53	Likely	Very Likely	Very Likely
19	Very Likely	Very Likely	Very Likely	54	Likely+	Likely	Very Likely
20	Very Likely	Very Likely	Very Likely	55	Possible	Likely+	Very Likely
21	Unlikely	Possible	Likely	56	Unlikely	Unlikely	Very Likely
22	Very Likely+	Very Likely	Very Likely	57	Unlikely	Unlikely	Very Likely
23	Unlikely	Possible	Very Likely	58	Very Likely	Very Likely	Very Likely
24*	Unlikely	Unlikely	Unlikely	59	Very Likely	Very Likely	Very Likely
25	Possible+	Possible+	Very Likely	60	Unlikely	Likely	Very Likely
26	Very Likely	Very Likely	Very Likely	61	Unlikely	Unlikely	Likely
27	Likely+	Likely	Very Likely	62	Very Likely+	Very Likely+	Very Likely
28	Likely+	Very Likely	Very Likely	63	Very Likely	Very Likely	Very Likely
29*	Unlikely	Unlikely	Unlikely	64*	Unlikely	Unlikely	Unlikely
30	Possible+	Unlikely	Very Likely	65	Very Likely	Very Likely	Very Likely
31*	Unlikely	Unlikely	Unlikely	66*	Unlikely	Unlikely	Unlikely
32	Very Likely	Very Likely	Very Likely	67	Unlikely	Unlikely	Very Likely+
33	Unlikely	Likely+	Very Likely	68	Unlikely	Unlikely	Very Likely
34	Unlikely	Unlikely	Very Likely+	69	Unlikely	Unlikely	Likely
35	Very Likely+	Very Likely+	Very Likely				

San Onofre 2

Seabrook

Indian Point 3

HB Robinson

Salem 1

Salem 2

Palisades

Indian Point 2

Millstone 2

Millstone 3

San Onofre 3

Davis-Besse

Source: NUREG/CR-6762 v1 dated 08/2002

Ignored Risk Factor

B 3.5.2 ECCS - Operating

BASES

BACKGROUND The function of the ECCS is to provide core cooling and negative reactivity to ensure that the reactor core is protected after any of the following accidents:

a. Loss of coolant accident (LOCA), coolant leakage greater than the capability of the normal charging system,

b. Rod ejection accident,

c. Loss of secondary coolant accident, including uncontrolled steam release or loss of feedwater, and

d. Steam generator tube rupture (SGTR).

The addition of negative reactivity is designed primarily for the loss of secondary coolant accident where primary cooldown could add enough positive reactivity to achieve criticality and return to significant power.

There are three phases of ECCS operation: injection, cold leg recirculation, and hot leg recirculation. In the injection phase, water is taken from the refueling water storage tank (RWST) and injected into the Reactor Coolant System (RCS) through the cold legs. When sufficient water is removed from the RWST to ensure that enough boron has been added to maintain the reactor subcritical and the containment sumps have enough water to supply the required net positive suction head to the ECCS pumps, suction is switched to the containment sump for cold leg recirculation. After approximately 24 hours, the ECCS flow is shifted to the hot leg recirculation phase to provide a backflush, which would reduce the boiling in the top of the core and any resulting boron precipitation.

ECCS recirculation phase "Very Likely" to be lost during large LOCA at 37 reactors before GSI-191 fixes

Source: NUREG-1431, R1 12/2005

Ignored Risk Factor

BASES

APPLICABILITY (continued)

This LCO is only applicable in MODE 3 and above. Below MODE 3, the SI signal setpoint is manually bypassed by operator control, and system functional requirements are relaxed as described in LCO 3.5.3, "ECCS - Shutdown."

In MODES 5 and 6, plant conditions are such that the probability of an event requiring ECCS injection is extremely low. Core cooling requirements in MODE 5 are addressed by LCO 3.4.7, "RCS Loops - MODE 5, Loops Filled," and LCO 3.4.8, "RCS Loops - MODE 5, Loops Not Filled." MODE 6 core cooling requirements are addressed by LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation - High Water Level," and LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation - Low Water Level."

ACTIONS

A.1

With one or more trains inoperable and at least 100% of the ECCS flow equivalent to a single OPERABLE ECCS train available, the inoperable components must be returned to OPERABLE status within 72 hours. The 72 hour Completion Time is based on an NRC reliability evaluation (Ref. 5) and is a reasonable time for repair of many ECCS components.

An ECCS train is inoperable if it is not capable of delivering design flow to the RCS. Individual components are inoperable if they are not capable of performing their design function or supporting systems are not available.

Without ECCS, reactor can only be "safely" operated for 72 hours, not 5,132 days

Source: NUREG-1431, R1 12/2005

Ignored Risk Factor

NRC staff justified operation of reactors while GSI-191 was resolved based on low probability that LOCA would occur

In isolation, justification may be appropriate; but reactors did not and will not operate with only unresolved GSI-191 safety issues

Ignored Risk Factor

While GSI-191 was unresolved, NRC issued Bulletin 2002-02 about increased probability of a LOCA due to CRDM nozzle cracking

NRC staff justified operation of reactors while Bulletin 2002-02 was resolved based on high reliability of ECCS systems

Ignored Risk Factor

ECCS impairment (GSI-191) was accepted based on low likelihood of LOCA

Increased LOCA likelihood (Bulletin 2002-02) was accepted based on unimpaired ECCS performance

NRC made both decisions in isolation

Ignored Risk Factor

UCS is not saying or implying that either of these NRC decisions was wrong or would have been different had all known risk factors been considered

BUT, we are saying that it is wrong to make risk decisions ignoring known risk factors

Risk-Informed Decision-Making

To properly reach risk-informed regulatory decisions, the risk of known but unresolved safety issues must be considered, at least qualitatively

Until resolved, GSI-191 risks along with risks from all open Bulletins, Generic Letters, NOEDs, URIs, etc must be considered

Risk-Informed Decision-Making

Example: A decision for a reactor with known Initiating Event problems might differ *from* that made for reactors with no known problems.

2Q/2010 ROP Performance Indicators Summary

Plants	IE 01	IE 03	IE 04	MS 05	MS 06	MS 07	MS 08	MS 09	MS 10	BI 01	BI 02	EP 01	EP 02	EP 03	OR 01	PR 01
Arkansas Nuclear 1	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Arkansas Nuclear 2	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Springfield 1	R	Y	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Springfield 2	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Braidwood 1	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Braidwood 2	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Browns Ferry 1	G	G	G	G	I	I	I	I	I	G	G	G	G	G	G	G
Browns Ferry 2	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Browns Ferry 3	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Brunswick 1	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Brunswick 2	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G

Risk-Informed Decision-Making

Many utilities use a design change checklist to review whether a proposed modification could adversely impact fire protection, environmental qualification, seismic design, and other safety factors.

Risk-Informed Decision-Making

NRC could employ a risk-informed decision checklist to review whether a proposed decision could affect or be affected by plant-specific unresolved safety issues (e.g., GSI-191, NEODs, inspection report URIs, greater-than-green ROP results, one-time exemptions, etc.)

Conclusion

UCS supports the NRC staff's recommendation that Options 1.b and 2 be used to closeout GSI-191

Regardless of options chosen, the risks associated with unresolved GSI-191 issues must be formally factored into NRC's regulatory decision-making

Back-up Slides

MATRIX OF LICENSEE MODIFICATIONS TO ADDRESS GENERIC SAFETY ISSUE 191

Source: NEI, 01/30/2007

Plant (Note: Asterisk indicates extension request approved or requested - See following table)	Original Strainer Area (Ft2)	Estimated Total size of Replace-ment Strainer (Ft2)	Strainer vendor	Strainer area shared between trains? (Yes/No)	Planned or actual quarter / year for strainer installation	pH Buffer change being pursued? (Yes/No)	If Yes, planned or actual quarter / year for pH Buffer change	Major (20% or more) insulation change out planned? (Yes/No)	If Yes, planned or actual quarter/year for completion of the insulation change	Major ECCS system mods (e.g., throttle valve/pump changes and cyclone separator removal) planned? (Yes/No)	If Yes, planned or actual quarter/year for completion of the changes	Any major containment spray system modifications planned? (Yes/No)	If Yes, planned or actual quarter/year for completion of the changes
Arkansas Nuclear One 1	179	TBD	CCI	Yes	1Q07	TBD	N/A	TBD	N/A	TBD	N/A	Ongoing	N/A
Arkansas Nuclear One 2	154	~4600	CCI	Yes	3Q06	TBD	N/A	No	N/A	TBD	N/A	Ongoing	N/A
Beaver Valley 1	130	3000	CCI	Yes	4Q07	No	N/A	No	N/A	Yes – throttle valve replacement	4Q07	Yes	4Q07
Beaver Valley 2*	150	3300	Enercon	Yes	4Q06	No	N/A	Yes	1Q08	Yes – throttle valve replacement	1Q08	Yes	1Q08
Braidwood 1	150 (total two sumps)	3000 per sump (2 sumps)	CCI	No	4Q07	No	N/A	Yes	4Q07	Yes - throttle valve trim replacement; separator testing	4Q07	No	N/A
Braidwood 2*	150 (total two sumps)	3000 per sump (2 sumps)	CCI	No	4Q06	No	N/A	No	N/A	Yes - throttle valve trim replacement; separator testing	2Q08	No	N/A
Byron 1*	150 (total two sumps)	3000 per sump (2 sumps)	CCI	No	3Q06	No	N/A	Yes	3Q06	Yes - throttle valve trim replacement; separator testing	2Q08	No	N/A
Byron 2	150 (total two sumps)	3000 per sump (2 sumps)	CCI	No	2Q07	No	N/A	No	N/A	Yes - throttle valve trim replacement; separator testing	2Q07	No	N/A
Callaway	~400 total (both trains)	~6600 total (both trains)	PCI	No	2Q07	No	n/a	No	N/A	No, not currently. Potential minor modification to cyclone separators	N/A	No	N/A
Calvert Cliffs 1*	102	6000	CCI	Yes	1Q07	No	N/A	No	N/A	TBD	N/A	No	N/A
Calvert Cliffs 2	102	6000	CCI	Yes	1Q08	No	N/A	No	N/A	TBD	N/A	No	N/A
Catawba 1*	135	2441	Enercon	Yes	2Q08	No	N/A	TBD	TBD	Yes - ECCS Injection Line Orifice replacements	4Q06	Under consideration	TBD
Catawba 2	135	2441	Enercon	Yes	4Q07	No	N/A	TBD	TBD	Yes - ECCS Injection Line Orifice replacements	4Q07	Under consideration	TBD
Comanche Peak 1	260 per sump	3947 per sump	PCI	No	1Q07	Yes	4Q07 or later	No	N/A	No	N/A	No	N/A
Comanche Peak 2	260 per sump	3947 per sump	PCI	No	4Q06	Yes	4Q07 or later	No	N/A	No	N/A	No	N/A
Cook 1*	85	900 (Phase 1 installed); Approx 2000 final	CCI	Yes	Phase 1 - 4Q06; Phase 2 - 2Q08	No	N/A	No	N/A	No	N/A	Yes - Water Management Pilot Plant. Specifics of changes TBD	N/A
Cook 2	85	Approx 2000	CCI	Yes	4Q07	No	N/A	No	N/A	No	N/A	Yes - Water Management Pilot Plant. Specifics of changes TBD	N/A
Crystal River Unit 3	86	1139	Enercon	Yes	4Q05	No	N/A	Yes	4Q09	Yes – cyclone separator modification	4Q07	No	N/A
Davis-Besse	50	1230	Enercon	Yes	2004	No	N/A	No	N/A	Yes (completed rather than planned). Included HPI pump modifications and cyclone separator modifications	2004	No	N/A
Diablo Canyon 1	700	3400	GE	Yes	2Q07	No	N/A	Yes	2Q07	No	N/A	No	N/A
Diablo Canyon 2*	700	3400	GE	Yes	1Q08	No	N/A	Yes	1Q08	No	N/A	No	N/A
Farley 1	100 to 200	3000	GE	No	1Q07	No	N/A	No	N/A	Yes, branch line resistance flow orifices	2Q07	No	N/A
Farley 2	100 to 200	3000	GE	No	4Q07	No	N/A	No	N/A	Yes - branch line resistance flow orifices	4Q07	No	N/A

Larger Screens + Less Debris = Lower Clogging Threat

Magnitude of GSI-191 Benefit

Source: NRC memo 08/20/2004

- 25 reactors very likely to have sump clogging for any size LOCA
- 6 reactors very likely to have sump clogging for large and medium LOCA
- 6 reactors very likely to have sump clogging for large LOCA and likely for medium LOCA

Total averted cost: $172,000,000