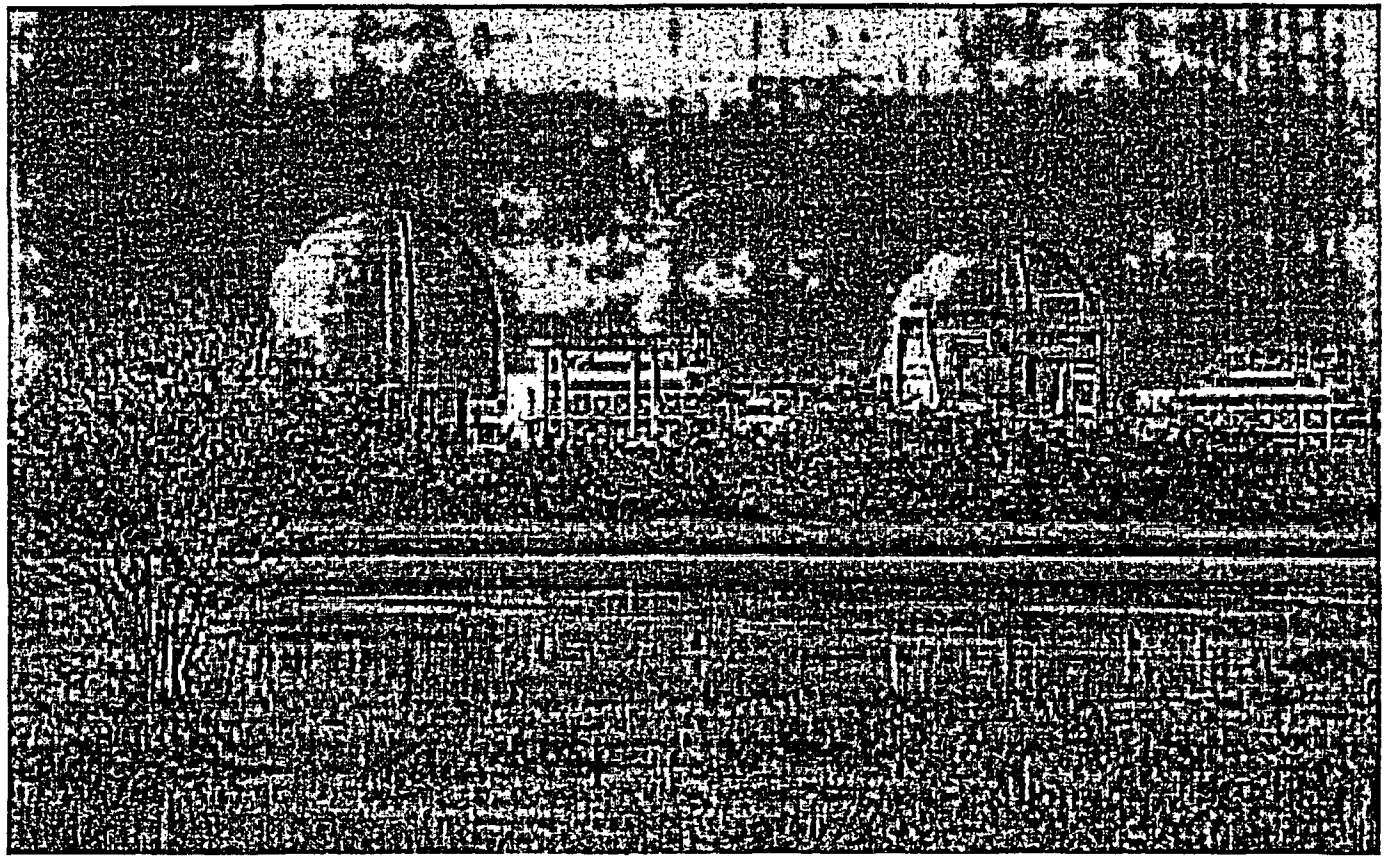
STPEGS

Risk-Informed Inservice Testing



RISK-INFORMED INSERVICE TESTING AT THE SOUTH TEXAS PROJECT

A proposal to apply
risk-informed criteria to inservice
testing of pumps and valves

STP Participants

- Scott Head Manager, Licensing
- Brad Scott Inservice Testing Program Coordinator
- Bill Stillwell Supervisor, Risk Management
- Glen Schinzel Supervisor, Risk Implementation

Purpose of Meeting

- Explain rationale for applying RI criteria to IST of pumps and valves
- Receive NRC feedback on proposed RI-IST submittal

Agenda

- Describe RI-IST methodology to support resubmittal using SONGS approach.
- Compare RI-IST treatment determination to GQA risk categorization for Exemption.
- GQA and RI-IST comparison.
- Address NRC's questions from previous submittal.

History

RI-IST

- 12/1999
  RI-IST process begins
- 05/21/2001
  Relief request submitted
- 04/09/2002
  NRC questions issued
- 11/12/2002
  Revised relief request submitted
- 05/29/2003
  NRC questions issued
- 09/12/2003
  Withdrawn

Special Treatment Exemption

- 07/13/1999
  Exemption request submitted
- 08/31/2000
  Revised exemption request submitted
- 11/15/2000
  NRC preliminary assessment
- 05/08/2001
  Revised exemption request submitted
- 06/05/2001
  Preliminary safety evaluation
- 06/08/2001
  Environmental assessment/no significant hazards
- 07/03/2001
  Comments on Safety Evaluation
- 08/03/2001
  NRC Safety Evaluation - Approval

Proposed Alternative

- Define inservice testing treatments for non-exempt components consistent with importance.
- Establish test intervals and treatments for pumps and valves using risk-informed classification as an alternative to ASME Section XI requirements.

Method of Application

- Proposed application of risk-informed classification of SSCs at STP follows the San Onofre approach.
- San Onofre approach has been approved by the NRC.
- RG 1.175 criteria are satisfied by the test strategies.

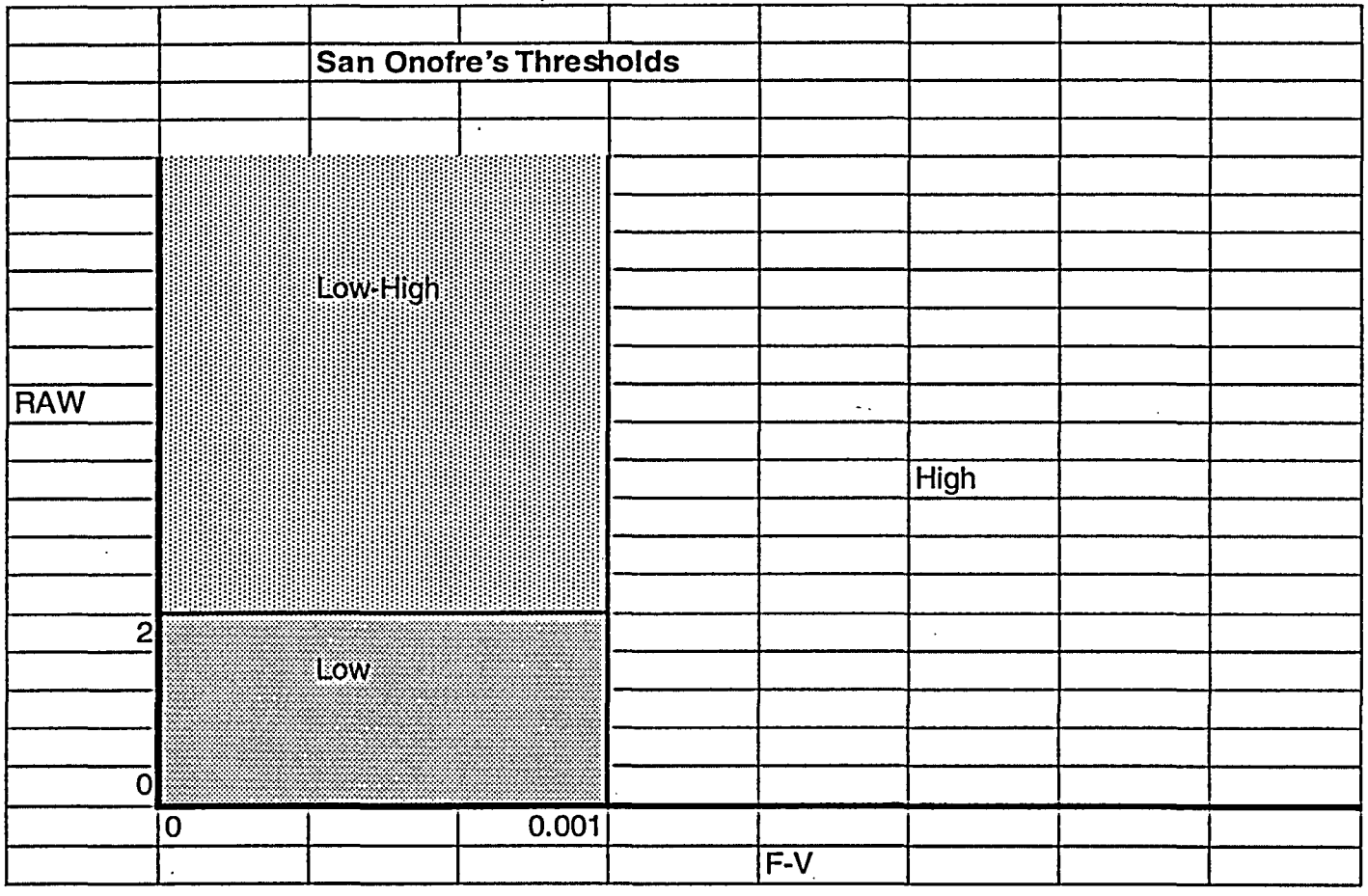
Benefits of RI-IST

- Enhance nuclear safety
- Focus resources on highest risk equipment
- Save $80,000 per year

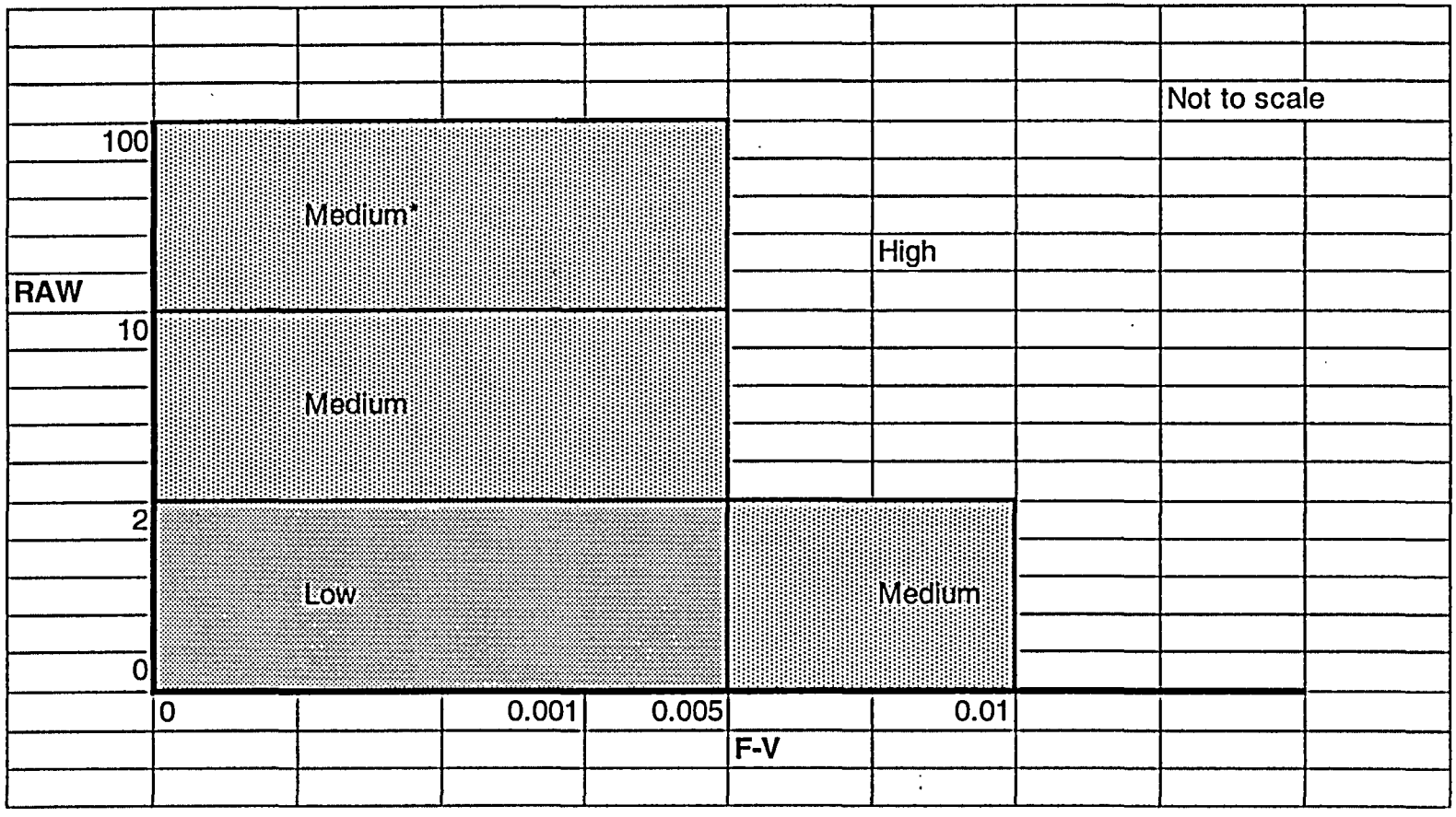
Key Differences from Previous Submittal

- F-V threshold adjusted from 0.005 to 0.001
- Treatment of common cause in RAW adjusted

Proposed Risk Thresholds



STP Exemption (GQA) Thresholds



STP F-V Number per SONGS Template

- All failure modes are included in F-V values
- Common cause is included. Results in a higher F-V value, thus encompassing more SSCs as highly significant to safety.
- Threshold for F-V is .001 for components highly significant to safety, instead of .005. This includes more SSCs as being highly significant to safety.
- F-V (high or low) determines treatment.

STP RAW per SONGS Template

- Common cause is not included in the RAW.
- Results in lower RAW, encompassing fewer components in mid-range of safety significance.
- RAW is reviewed if component is classed as having low safety significance.
- RAW of 2 is consistent with code case OMN-3.

Risk-Informed Classifications

- If F-V value is greater than 0.001, treatment classification is “high”.
- If F-V value is less than 0.001 and RAW > 2, treatment classification is “low/high”.
- If F-V value is less than 0.001 and RAW < 2, treatment classification is “low”.

Comparison With Other Plants

Rank	Comanche Peak	SONGS	STP IST
High	138 SSCs – 20.7%	57 SSCs – 13.1%	71 SSCs – 13.2%
Low/High	NA	32 SSCs – 7.4%	22 SSCs – 4.1%
Low	529 SSCs – 79.3%	346 SSCs – 79.5%	444 SSCs – 82.7%

Relationship to Exemption

- Exemption Request removes designated SSCs from scope of 10CFR50.
- RI-IST categorizes by significance those SSCs remaining under the scope of 10CFR50.
- RI-IST will not affect GQA categorization results

Comparing Classifications

- There are no SSCs in the Exemption categorized as having low safety significance or no risk significance that are also ranked "high" for RI-IST.
- SSCs categorized as having low safety significance or no risk significance are not in RI-IST scope.

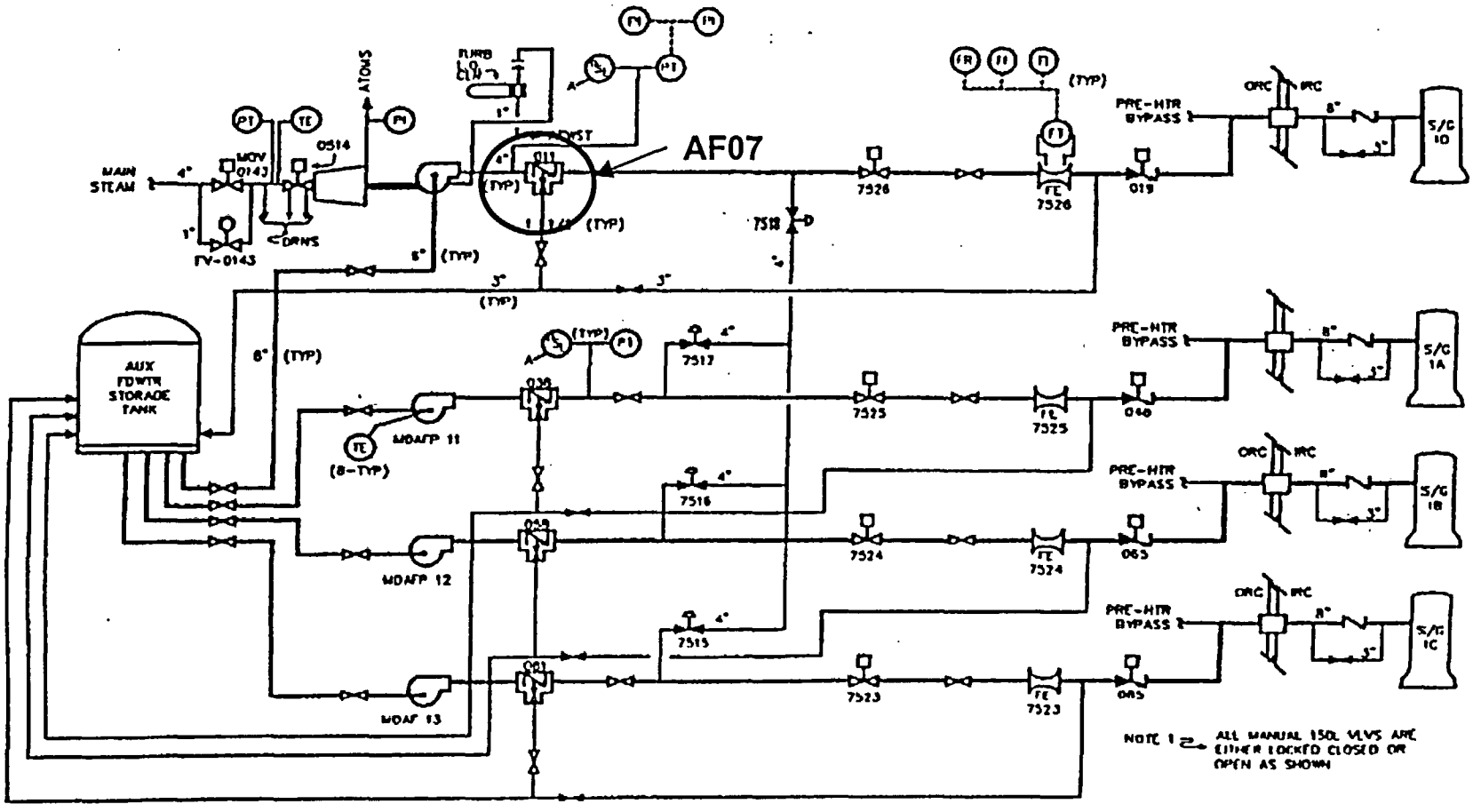
Ranking Philosophies

- GQA
  - Categorization intended for Global / General Use
  - System functions are first identified and ranked
  - Each component is then tied to the functions that the component supports
  - Component categorized based on highest ranking function supported
  - Some components downgraded based on redundancy, diversity, etc.
- IST
  - Starts at component level and determines relative redundancy available for component and for the function being tested.
  - Categorization of SSCs does not impact program scope
  - Categorization adjusts test treatments only

RI-IST PROGRAM MATRIX

EXEMPTION CATEGORIES		IST TREATMENT		
		HIGH	LOW/HIGH	LOW
	HIGH	SSC Not Exempt 14 Valve Groups - 49 Valves 6 Pump Groups - 16 Pumps	SSC Not Exempt 5 Valve Groups - 16 Valves 1 Pump Group - 3 Pumps	SSC Not Exempt 9 Valve Groups - 28 Valves 1 Pump Group - 3 Pumps
	MEDIUM	SSC Not Exempt 2 Valve Groups - 6 Valves 0 Pump Groups - 0 Pumps	SSC Not Exempt 1 Valve Group - 3 Valves 0 Pump Groups - 0 Pumps	SSC Not Exempt 43 Valve Groups - 150 Valves 2 Pump Groups - 4 Pumps
	LOW	SSC Exempt NONE	SSC Exempt NONE	SSC Exempt 122 Valve Groups - 251 Valves 3 Pump Groups - 8 Pumps
	NRS	SSC Exempt NONE	SSC Exempt NONE	SSC Exempt NONE

Auxiliary Feedwater System



Group AF07 - AFW Auto Recirc Valve AF0011

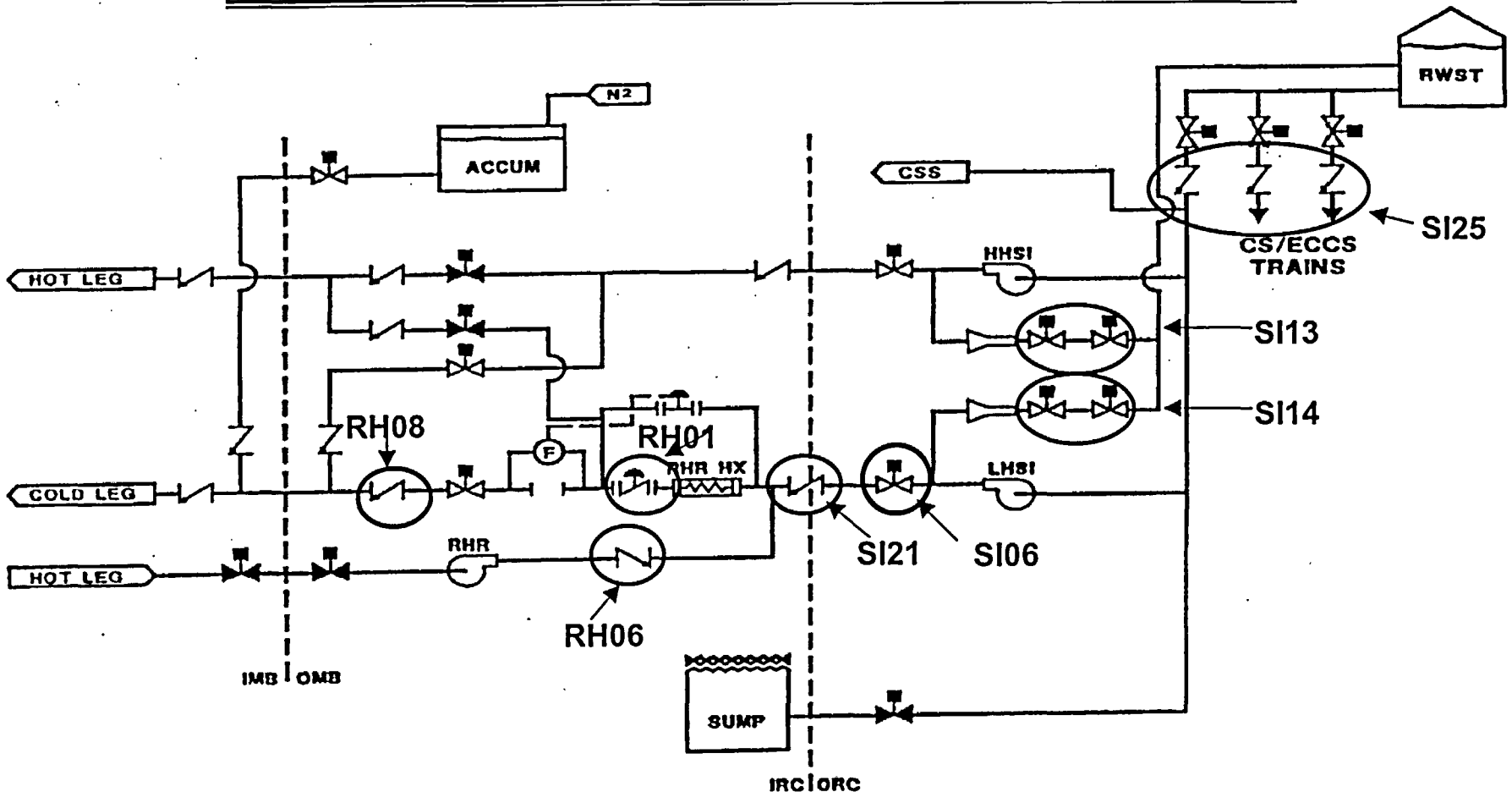
GQA

- Rank = High
- Bases
  Supports the following system functions:
  - High risk
    - Prevent pump damage from insufficient flow or excessive flow
    - Supply feedwater to SGs to remove reactor core decay heat if normal feedwater is unavailable
  - Medium risk
    - Provide feedwater to the SGs during startup, initial fill & wet lay-up, shutdown, hot standby, and cool-down & heatup
- GQA ranked High based on:
  - Initial PRA rank of High, subsequently lowered to Medium
  - Supports High risk functions
  - No credit taken for redundancy

RI-IST

- Treatment = Low/High
- F-V = 7.5E-4
- RAW = 2.9
- Bases
  - Valve opens, allows flow to SG during accident
  - 2/4 AF trains required for immediate response; 1 train for long-term
  - Valve opens to allow minimum recirculation flow (not safety; pump protection only)
  - RI-IST treatment
    - F-V and RAW
    - Valve failure affects only 1 of 4 AFWP
    - AFW x-connections allow flow from any AFWP to any SG

Emergency Core Cooling System



Group RH01 - RHR HX Control AOVs CV0864,5,6

GQA

- Rank = Medium
- Bases
  Supports the following system functions:
  - High risk
    - Long term decay heat removal during the SI recirculation phase of a small or large break LOCA
    - Serve as part of the ECCS LHSI flow path during SI
    - Remove core decay heat and sensible heat to achieve and maintain cold shutdown following: feedwater line break, secondary steam line break, and SGTR
    - Remove residual and sensible heat during drain down and mid-loop operations
  - Medium risk
    - Remove residual and sensible heat during reactor hot and cold shutdown following normal reactor shutdown
    - Provide pressure boundary
- GQA ranked Medium based on:
  - Initial PRA rank of Medium, subsequently lowered to Low
  - Redundant Trains
  - Power removed during modes 1, 2, and 3
  - Valve is normally open and stays open to support the High risk functions. Transfer closed is not a credible failure

RI-IST

- Treatment = Low
- F-V = 3.0E-4
- RAW = 1.2
- Bases
  - Open for normal lineup for SI and long-term recirculation
  - NO, FO, de-energized in "open" during Modes 1-3
  - Control function not safety; full open allows max heat removal
  - RI-IST treatment
    - F-V and RAW
    - 3 trains RHR available; only 1 required
    - NO, FO, de-energized in "open" in Modes 1-3

Group RH06 - RHR Discharge Check Valve

GQA

- Rank = High
- Bases
  Supports the following system functions:
  - High risk
    - Long term decay heat removal during the SI recirculation phase of a small or large break LOCA
    - Serve as part of the ECCS LHSI flow path during safety injection
    - Remove core decay heat and sensible heat to achieve and maintain cold shutdown following: feedwater line break, secondary steam line break, and SGTR
    - Remove residual and sensible heat during drain down and mid-loop operations
  - Medium risk
    - Remove residual and sensible heat during reactor hot and cold shutdown following normal reactor shutdown
    - Provide pressure boundary
- GQA ranked High based on:
  - Initial PRA rank of High, subsequently lowered to Low
  - Supports High risk functions
  - No credit taken for redundancy

RI-IST

- Treatment = Low
- F-V = 6.7E-5
- RAW = 1.1
- Bases
  - Open to allow safety cooldown using RHR
  - "Close" not safety function
  - RI-IST
    - F-V and RAW
    - 3 trains RHR available; only 1 required

Group RH08 - RHR Cold Leg Inj Check Valve

GQA

- Rank = High
- Bases
  Supports the following system functions:
  - High risk
    - Long term decay heat removal during the SI recirculation phase of a small or large break LOCA
    - Serve as part of the emergency core cooling system (ECCS) LHSI flow path during safety injection
    - Remove core decay heat and sensible heat from the reactor core and RCS to achieve and maintain cold shutdown after feedwater line break, secondary steam line break, and SGTR
    - Remove residual and sensible heat from the reactor core and the RCS during drain down and mid-loop operations
  - Medium risk
    - Remove residual and sensible heat from the reactor core and the RCS during reactor hot and cold shutdown following normal shutdown
    - Provide pressure boundary
- GQA ranked High based on:
  - Initial PRA rank of High, subsequently lowered to Medium
  - Supports High risk functions
  - No credit taken for redundancy

RI-IST

- Treatment = Low
- F-V = 9.2E-5
- RAW = 1.2
- Bases
  - Close and leaktight to maintain RCPB
  - Open to allow safety cooldown with RHR
  - Open to allow SI path for LHSI
  - RI-IST treatment
    - F-V and RAW
    - 3 trains RHR available; only 1 required
    - 3 trains LHSI available; only 1 required
    - valves are closed and leak tested prior to reactor startup per TS
    - leak-by condition monitored daily per RCS inventory TS requirement

Group SI13 - HHSI Recirc Isol MOV SI0011, 12

GQA

- Rank = High
- Basis
  Supports the following system functions:
  - High risk
    - Cold leg recirculation mode - recirculate borated water from the containment sump, through the RHR heat exchangers, and back to the RCS cold legs
  - Medium risk
    - Support automatic switchover from the injection mode to the cold leg recirculation mode (manual backup available)
    - Prevent pump damage from insufficient or excessive flow (orifices and mini-flow lines)
- GQA ranked High based on:
  - PRA rank of High
  - Supports High risk functions
  - No credit taken for redundancy

RI-IST

- Treatment = High
- F-V = 5.2E-3
- RAW = 3.3
- Bases
  - Remain open for HHSI minimum recirculation path
  - Close to isolate flow to RWST during switchover to sump
  - NO, FAI
  - RI-IST treatment
    - F-V
    - Valve FAI so "open" function is satisfied even if valve fails
    - Redundant closing function provided by 2 valves in series
    - 2 additional HHSI trains provide SI if both valves fail to close

Group SI14 - LHSI Recirc Isol MOVs SI0013, 14

GQA

- Rank = High
- Basis
  Supports the following system functions:
  - High risk
    - Cold leg recirculation mode - recirculate borated water from the containment sump, through the RHR heat exchangers, and back to the RCS cold legs
  - Medium risk
    - Support automatic switchover from the injection mode to the cold leg recirculation mode (manual backup available)
    - Prevent pump damage from insufficient or excessive flow (orifices and mini-flow lines)
- GQA ranked High based on:
  - PRA rank of High
  - Supports High risk functions
  - No credit taken for redundancy

RI-IST

- Treatment = High
- F-V = 2.5E-3
- RAW = 1.2
- Bases
  - Remain open for LHSI minimum recirculation path
  - Close to isolate flow to RWST during switchover to sump
  - NO, FAI
  - RI-IST treatment
    - F-V
    - Valves FAI so "open" function is satisfied even if valves fail
    - Redundant closing function provided by 2 valves in series
    - 2 additional LHSI trains provide SI if both valves fail to close

Group SI21 - LHSI Containment Isol Check Valve

GQA

- Rank = High
- Bases
  Supports the following system functions:
  - High risk
    - Injection mode - deliver borated water from RWST and accumulators to RCS cold legs to make up for loss of coolant resulting from a LOCA, rod ejection accident, or SGTR
    - Cold leg recirculation mode - recirculate borated water from the containment sump, through the RHR heat exchangers, and back to the RCS cold legs
  - Medium risk
    - Hot leg recirculation mode - recirculate borated water from the containment sump simultaneously to the RCS hot legs by one train and to a cold leg by another train
- GQA ranked High based on:
  - Initial PRA rank of High, subsequently lowered to Low
  - Supports High risk functions
  - No credit taken for redundancy

RI-IST

- Treatment = Low
- F-V = 4.8E-4
- RAW = 1.2
- Bases
  - Close and leaktight for containment isolation; also close to prevent RHR backflow
  - Open to allow LHSI during accident and sump recirculation
  - Open to inject borated water during long-term cooling (hot-leg and cold-leg recirculation)
  - RI-IST treatment
    - F-V and RAW
    - 2 additional LHSI trains to provide SI if one valve fails to open

Group SI25 - SI Suction Check Valve SI0002

GQA

- Rank = High
- Bases
  Supports the following system functions:
  - High risk
    - Injection mode - deliver borated water from RWST and accumulators to RCS cold legs to make up for loss of coolant resulting from a LOCA, rod ejection accident, or SGTR
    - Injection mode - supply borated water to compensate for positive reactivity inserted and make up for shrinkage of reactor coolant from a decrease in temperature caused by secondary steam line break, feedline break, or main steam line depressurization
  - Supports the following Medium risk system function
    - Support the automatic switchover from the injection mode to the cold leg recirculation mode
- GQA ranked High based on:
  - Initial PRA rank of High, subsequently lowered to Medium
  - Supports High risk functions
  - No credit taken for redundancy

RI-IST

- Treatment = Low
- F-V = 3.9E-4
- RAW = 3.5
- Bases
  - Open to allow suction to LHSI, HHSI, CS pumps
  - Close to prevent backflow to RWST during sump recirculation
  - Check valves stop backflow from RWST until SI MOV0001 valves close
  - RI-IST treatment
    - F-V and RAW
    - Redundant closing function provided by upstream MOV
    - 2 additional trains of LHSI, HHSI, CS provide safety function if 1 valve fails

Group SILHP - LHSI Pump PA102

GQA

- GQA Rank: High
- Basis
  Supports the following system functions:
  - High risk
    - Injection and Cold leg Recirc modes
  - Medium risk
    - Hot leg recirculation mode
  - Low risk
    - Pressure boundary and positive RCS volume control
- GQA ranked High based on
  - Initial PRA rank of High, subsequently lowered to Medium*
  - Supports High risk functions
  - No credit taken for redundancy

RI-IST

- Treatment = Low
- F-V = 7.8E-4
- RAW = 1.2
- Basis:
  - F-V and RAW
  - Active function to 'start and run' to support injection and recirculation functions
  - Redundancy exists with three 100% safety trains to satisfy the injection modes
  - Diversity exists with 3 High Head pumps to support recirculation and injection

Group SI06 - LHSI Isolation MOV

GQA

- GQA Rank: Medium
- Basis
  Supports the following system functions:
  - High risk:
    - Injection and Cold leg recirculation modes
  - Medium risk
    - Hot leg recirculation mode
  - Low risk
    - Pressure boundary and Containment Isolation
- GQA ranked Medium based on:
  - Initial PRA rank of Medium, subsequently lowered to Low
  - Redundant Trains
  - Valve is normally open and stays open to support the High risk functions. Transfer closed is not a credible failure
  - Valve is closed to isolate RHR from the LHSI pump when the RHR pump is used for long term accident recovery. Failure to close mitigated by the inside containment check valve.

RI-IST

- Treatment = Low
- F-V = 4.3E-4
- RAW = 1.2
- Bases:
  - Valve is normally open - satisfies its safety function
  - The 'remain open' function is passive
  - IST testable function is to 'close on demand'
  - RI-IST Treatment of Low based on:
    - Valve is normally in its required safety position – no change of state required
    - Redundancy exists with three 100% safety trains to satisfy the injection modes
    - Diversity exists with 3 High Head pumps to support recirculation and injection
    - Valve is routinely monitored by other means to check valve position and flow

Effects of RI-IST on SSC Treatments

Component Type	Requirement	High Treatment	Low/High Treatment	Low Treatment
Pumps	Testing	Code Inservice Test	Code Test on extended interval with compensatory measure	Code Test on extended interval
	Performance Monitoring	(Vibration Monitoring, Oil Analysis, Thermography, etc.)	(Vibration Monitoring, Oil Analysis, Thermography, etc.)	(Vibration Monitoring, Oil Analysis, Thermography, etc.)
MOVs	Testing	Code Inservice Test and MOV Periodic Verification Program	MOV Periodic Verification Program	MOV Periodic Verification Program
	Performance Monitoring	Periodic inspections and maintenance activities	Periodic inspections and maintenance activities	Periodic inspections and maintenance activities
AOVs	Testing	Code Inservice Test	Code Test on extended interval with compensatory measure	Code Test on extended interval
	Performance Monitoring	JOG AOV Testing Program and Maintenance activities	JOG AOV Testing Program and Maintenance activities	JOG AOV Testing Program and Maintenance activities
Notes:				
1. Valves are exercised at least once every refuel cycle if practical.				
2. Extended intervals will not exceed 6 years plus 25% grace except where allowed by referenced programs or NUREG-1482.				
3. Performance monitoring described above is in addition to monitoring as required by the Maintenance Rule Program and CAP.				
4. Details of such activities are included in the RI-IST Program Summary.				

Effects of RI-IST on SSC Treatments

Component Type	Requirement	High Treatment	Low/High Treatment	Low Treatment
HOVs, SOVs, and Manual Valves	Testing	Code Inservice Test	Code Test on extended interval with compensatory measure	Code Test on extended interval
	Performance Monitoring	Periodic inspections and maintenance activities	Periodic inspections and maintenance activities	Periodic inspections and maintenance activities
Check Valves	Testing	Condition Monitoring IAW ASME Code Case OMN-4 (As endorsed in RG 1.192)	Condition Monitoring IAW ASME Code Case OMN-4 (As endorsed in RG 1.192)	Condition Monitoring IAW ASME Code Case OMN-4 (As endorsed in RG 1.192)
	Performance Monitoring	N/A	N/A	N/A
Relief Valves	Testing	Code Inservice Test	Code Inservice Test	Code Inservice Test
	Performance Monitoring	Test results trending, tighter reset tolerances	Test results trending, tighter reset tolerances	Test results trending, tighter reset tolerances
Notes:				
1. Valves are exercised at least once every refuel cycle if practical.				
2. Extended intervals will not exceed 6 years plus 25% grace except where allowed by referenced programs or NUREG-1482.				
3. Performance monitoring described above is in addition to monitoring as required by the Maintenance Rule Program and CAP.				
4. Details of such activities are included in the RI-IST Program Summary.				

Response to RAI

NRC Issue 1

The re-categorization process might not properly include components with important safety-significant functions within the scope of the RI-IST Program.

Response to Issue 1

- GQA ranking is unaffected by RI-IST importance determination.
- RI-IST treatment strategy process considers all safety significant functions for SSCs included in scope.
- RI-IST ranking determines the treatment requirements for components remaining within the scope of the program.

NRC Issue 2

CDF and LERF must include the cumulative impacts to the IST program resulting from the exemption process and the proposed RI-IST Program.

Response to Issue 2

- CDF and LERF will include the cumulative impacts to the IST program.
- Changes in CDF and LERF will still meet the requirements of RG 1.174 and RG 1.175.
- LRS and NRS components contribute minimally to the overall CDF and LERF.

NRC Issue 3

Without sufficient justification that the SSC cannot be in a non-normal state, re-categorize these SSCs and test the risk-important function, even if STP considers the SSC to be passive.

Response to Issue 3

- All failure modes are considered in the F-V ranking.

NRC Issue 4.a

The proposed RI-IST Program does not provide assurance that SSCs will be tested in a manner that collects sufficient performance information to support functionality over the test interval.

Response to Issue 4.a

- Treatments are consistent with those at SONGS.
- See slides 33 and 34.

NRC Issue 4.b

STP does not indicate that data and information will be obtained to allow evaluation of operating characteristics for safety-related AOVs other than those HSS under the proposed program. Implementation would not provide timely and systematic collection of data.

Response to Issue 4.b

- Treatments are consistent with those at SONGS.
- See slides 33 and 34.

NRC Issue 4.c

The proposed program is inconsistent with RG 1.175 for testing of SSCs categorized as LSS under the proposed program using test methods that support the extended test intervals.

Response to Issue 4.c

- Treatments are consistent with those at SONGS.
- See slides 33 and 34.

NRC Issue 4.d

The proposed RI-IST Program is inconsistent with the provisions for surveillance testing and monitoring of low safety-significant components which served as the basis for approval of the exemption request.

Response to Issue 4.d

- The program follows SONGS approach for low risk SSCs remaining in scope of the IST program.

NRC Issue 5.a

UFSAR states that HSS and MSS SSCs would continue to satisfy regulations, and HSS and MSS SSCs would be evaluated to determine whether enhanced treatment is warranted. The proposed program is inconsistent with the basis for the exemption request.

Response to Issue 5.a

- The program follows SONGS approach for low risk SSCs remaining in scope of the IST program.

NRC Issue 5.b

Proposed RI-IST Program does not specify adequate testing of safety significant functions of components where those functions could be, but are not, tested as part of the current IST program.

Response to Issue 5.b

- STP has added trending requirements for equipment not in the traditional scope of the OM Code.

NRC Issue 6

Implementation of defense strategies for common-cause failures has not been demonstrated to be sufficient to eliminate the need to address the potential for common cause failures under the RI-IST Program.

Response to Issue 6

- Common-cause failures across system boundaries are not routinely included in any PRA.
- STP includes common cause across multiple switchgear breakers for LOOP.
- STP includes models of common actuation systems with common cause included at the relay level.

Conclusions

- STP will submit an application consistent with the previously approved SONGS approach.
- Proposed alternative provides an acceptable level of quality and safety pursuant to 10CFR50.55a(a)(3)(i).