ITAAC Closure Verification Using Sample-Based Inspection Process

Presented At: Public Meeting

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Attachment 2

ITAAC Closure Working Group

- Formed in June 2007 with representatives from NRO, NRC Region II, and OGC.
- Meets monthly to solve issues associated with ITAAC closure
- Some topics include: 52.99, design acceptance criteria, site specific ITAAC, generic ITAAC inspection schedule, NRC process for ITAAC closure verification, and 10 CFR 950 on Standby Support.

Briefing Objective

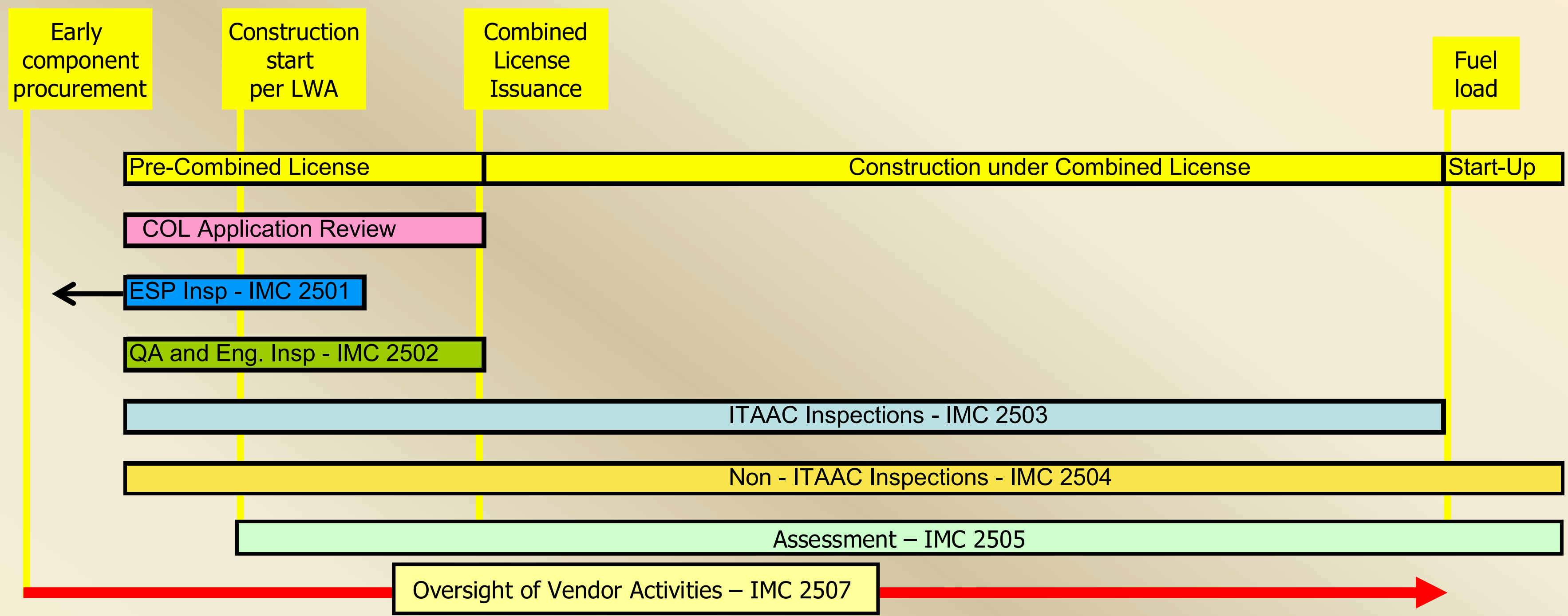
- Describe the staff approach to inspect and verify closure of ITAAC using a prioritizing and sampling approach.
- Describe why prioritization was chosen as an alternative to statistical acceptance sampling.
- Describe how the formal decision method formulates and ranks decision options (Weil and Apostolakis 2001).

Briefing Overview

- Background – Inspection of ITAAC is a subset of the overall NRC oversight
- Regulatory basis for ITAAC
- Grouping ITAAC
- Inspection prioritization process
- Results
- Conclusion

NRC CONSTRUCTION OVERSIGHT HAS MULTIPLE COMPONENTS

Oversight will assure plants are constructed as designed.



Abbreviations

ESP – Early Site Permit
IMC – Inspection Manual Chapter
ITAAC – Inspections, Tests, Analyses, and Acceptance Criteria
LWA – Limited Work Authorization

IMC 2501

-ESP QA controls on integrity & reliability of data collected for site characterization.
-ESP controls for application preparation

IMC 2502

-QA for design, procurement, & construction
-Translation of certified design into design details
-COL controls for application preparation

IMC 2503

Verification of successful performance of ITAAC-related activities

IMC 2504

-QA for construction & operations
-Problem identification, reporting, & corrective action
-Work planning/control over work & contractors
-Translation of certified design into design details
-Design change process
-Pre-operational & startup testing
-Operational programs & operational readiness

IMC 2505

-Guides inspection planning

IMC 2507

- Verification of QA program implementation, compliance, reporting and corrective action

ITAAC Basis

- Inspection, tests, analysis and acceptance criteria
- Provide reasonable assurance that the facility has been constructed and will be operated in conformity with the license, the provisions of the Atomic Energy Act, and the Commission's rules and regulations (10 CFR 52.97(b)(1))
- Required to be submitted in the design certification and license applications
- Reviewed and approved by NRC in conjunction with approval of a certified design or issuance of a COL

ITAAC Examples

Design Commitment	Inspection Test Analysis	Acceptance Criteria
The RCPs have a rotating inertia to provide RCS flow coastdown on loss of power to the pumps.	Inspection of the as-built RCP vendor data will be performed.	The calculated rotating inertia of 16,500 lb-ft^2.
Pressure boundary welds in components identified in Table 2.1.3-1 as ASME Code Section III meet ASME Code Section III requirements.	Inspection of the as-built pressure boundary welds will be performed in accordance with ASME Code Section III.	A report exists and concludes that ASME Code Section III requirements are met for NDE of pressure boundary welds.

ITAAC Timeline

- 05/09/05: NRC contracted ISL to recommend sampling process for inspecting ITAAC
- 09/30/05: ISL issued Technical Report on the Prioritization of Inspection Resources for Inspections, Tests, Analyses and Acceptance Criteria (ITAAC)
- 04/25/06: Issued IMC 2503, Inspections of ITAAC
- 06/01/06: Briefed ACRS
- 01/23/07: Public Meeting
- 03/08/07: SECY-07-0047 (ITAAC closure)
- 05/16/07: SRM on SECY 07-0047
- 06/14/07: ITAAC Closure Verification Working Group
- 07/11/07: Briefed ACRS on selection process for inspection

ITAAC Implementation

- Licensees perform 100% of ITAAC verification during construction
- NRC inspects a sample of ITAAC-related activities to verify proper ITAAC closure
- Licensee submits closure letter to the NRC
- NRC verifies closure of all ITAAC through documentation review
- NRC documents ITAAC closure verification in the Federal Register
- Commission ensures ITAAC are performed and prior to operation shall find that the acceptance criteria are met

Grouping ITAAC - Matrix

- Each certified reactor design has its own set of ITAAC including: piping, valves, welds, pumps, pipe supports, power supplies, cables, seismic qualification, etc. The total number of ITAAC range from 500 to 1000.
- For the AP-1000 and ABWR designs, the NRC staff evaluated all ITAAC and developed a *Matrix* organized by ITAAC common areas and programs applicable to those common areas. (Slide 11)

Grouping ITAAC

- 19 matrix rows – processes
- 6 matrix columns - programs
- The intersection of each row and column are called ITAAC *families* which have common characteristics and use the same IP.
- Observing performance of ITAAC activity within a family will provide insights that are applicable to the remainder of the family.

THE AP1000 ITAAC MATRIX

	A)As-Built Inspection	B)Welding	C)Construction Testing	D) Operational Testing	E)Qualification Criteria	F)Design/Fabrication Requirements
01)Foundations & Buildings	14				1	4
02)Structural Concrete			1			
03)Piping	10	10	10	4		17
04)Pipe Supports & Restraints						8
05)RPV & Internals	7	2	1	2	1	4
06)Mechanical Components	28	5	6	22	4	22
07)Valves	8	4	6	27	12	20
08)Electrical Components & Systems	15		5	24	8	8
09)Electrical Cable	10		1			11
10)I&C Components & Systems	61		35	63	16	9
11)Containment Integrity & Penetrations	6			1	1	1
12)HVAC	11	3	3	14	2	10
13)Equipment Handling & Fuel Racks	6			5	3	3
14)Complex Systems w/ Multiple Components	25			4	4	6
15)Fire Protection	7		1	2		
16)Engineering	5				2	10
17)Security	3				1	
18)Emergency Planning						
19) Radiation Protection	5				1	1

Rank-Ordering of ITAAC

- Rank-ordering of ITAAC inspection was based on *attributes and associated ITAAC impact* that make one ITAAC more or less important to inspect based on optimizing resources to minimize the possibility of a significant flaw going undetected.

- Step 1: Five *attributes* were developed: safety significance, propensity for making errors (includes higher complexity or inherently difficult tasks), construction and testing experience, opportunity to verify by other means, and licensee oversight.
- Step 2: Expert panels assigned relative weights for attributes using <u>AHP</u>. Then, utility values were assigned for each attribute.
- Step 3: Expert panels determined utility factors for each attribute for each ITAAC.
- Step 4: The results were fed into an algorithm which produced a listing of ITAAC "value of inspection" results.

ITAAC Attributes

- Propensity of Making Errors – The degree of propensity to making errors during fabrication, installation or testing. This may depend on complexity or inherent difficulty of the activity.
- Construction and Testing Experience – Relates to possible first-of-a-kind activity, or performed by company with little nuclear experience.
- Opportunity to Verify by Other Means – The degree that the activity can be verified by observing other functional, pre-operational or performance tests.
- Licensee Oversight Attention – The effectiveness and extensiveness of licensee's oversight attention and QA efforts, including their contractors and suppliers.
- Safety Significance – The safety significance assigned to the system, component, or structure included in the ITAAC.

☐Rank = ∑5 (Baseline utility (B)- "No Flag" utility(V)) (Attribute Specific Weighting Factor)

AP1000 ITAAC No.	Error Prop. (.05)		C & T Exper. (.09)		Verify by other (.19)		Lic. O/sight (.34)	Safety Signif. (.33)	ITAAC Delta Rank
	B	**V**	**B**	**V**	**B**	**V**	**B**	**B**	
3.3.2a.i	3	2	4	1	5	2	3	5	0.659
2.2.3.9a.1	2	2	3	1	4	1	3	4	0.431

ITAAC 3.3.2a.i - The as-built nuclear island structures, including critical sections, conform to design and will withstand design basis loads without loss of structural integrity.

Delta Rank = [(.313-.156).05+(.663-0).09+(1-.094).19+(.263).34+(1).33] = **.659**

ITAAC 2.2.3.9a.i - The calculated flow resistance for each in-containment refueling water storage tank drain line is satisfactory.

Delta Rank = [(.156-.156).05+(.325-0).09+(.594-0).19+(.263).34+(.606).33] = **.431**

AP1000 ITAAC Assigned to IP65001.06

Family 06A

As-Built Mechanical Components

ITAAC	Rank
2.2.02.07a.iii	0.160
2.2.02.07c	0.307
2.2.02.07f.ii	0.160
2.2.02.08a	0.160
2.2.03.08b.02	0.419
2.2.03.08c.ix	0.419
2.2.03.08c.v	0.419
2.2.03.08c.vi	0.419
2.2.03.08c.vii	0.419
2.2.03.08c.viii	0.419
2.2.03.08c.xi	0.419
2.2.03.08c.xiii	0.289
2.2.03.08d	0.289
2.3.02.08a.ii	0.124
2.3.03.03a	0.124
2.3.03.03b	0.124
2.3.03.03d	0.124
2.3.06.05a.i	0.124
2.3.07.07b.i	0.124
2.3.07.07b.ii	0.124
2.3.09.01	0.124
2.3.09.03.i	0.124
2.3.09.03.iv	0.124
2.3.10.05a.i	0.089
2.3.11.02.i	0.089
2.3.12.01	0.089
2.3.14.03	0.089
2.5.05.02.i	0.124

Family 06B

Welding Mechanical Components

ITAAC	Rank
2.1.02.03a	0.520
2.2.01.03a	0.520
2.2.03.03a	0.520
2.3.02.03a	0.225
2.3.06.03a	0.261

Family 06C

Construction Testing Mechanical Components

ITAAC	Rank
2.1.02.04a	0.289
2.1.02.08c	0.367
2.2.01.04a.i	0.419
2.2.03.04a	0.289
2.3.02.04a	0.089
2.3.06.04a	0.124

Family 06D

Operational Testing Mechanical Components

ITAAC	Rank
2.1.02.08b	0.497
2.2.02.07a.i	0.381
2.2.02.07b.i	0.400
2.2.02.07d	0.381
2.2.02.07e.ii	0.178
2.2.02.07f.i	0.178
2.2.03.08b.01	0.596
2.2.03.08c.i	0.569

Family 06D

Operational Testing Mechanical Components

ITAAC	Rank
2.2.03.08c.ii	0.562
2.3.02.08a.i	0.142
2.3.02.08a.iii	0.142
2.3.02.08b	0.089
2.3.02.12b	0.124
2.3.03.03c	0.142
2.3.06.09b.ii	0.178
2.3.06.09c	0.178
2.3.06.09d	0.178
2.3.07.08.ii	0.142
2.3.08.02.i	0.178
2.3.08.02.i	0.178
2.3.09.03.ii	0.219
3.3.10.i	0.497
3.3.10.ii	0.529

Family 06E

Qualification Criteria Mechanical Components

ITAAC	Rank
2.3.06.05a.ii	0.295
2.3.10.05a.ii	0.260
2.3.11.02.ii	0.260
2.5.05.02.ii	0.295

Family 06F

Design/Fab Requirements Mechanical Components

ITAAC	Rank
2.1.02.02a	0.532

Family 06F

Design/Fab Requirements Mechanical Components

ITAAC	Rank
2.2.01.02a	0.532
2.2.01.04a.ii	0.622
2.2.02.05c	0.300
2.2.02.07a.ii	0.381
2.2.02.07b.ii	0.402
2.2.02.07b.iii	0.402
2.2.03.02a	0.532
2.2.04.08b.ii	0.160
2.3.01.03.i	0.269
2.3.02.02a	0.237
2.3.03.02	0.277
2.3.03.02	0.277
2.3.06.02a	0.273
2.3.06.05a.iii	0.301
2.3.06.09b.i	0.287
2.3.07.08.i	0.252
2.3.08.02.ii	0.287
2.3.10.05a.iii	0.265
2.3.10.05a.iii	0.265
2.3.11.02.iii	0.235
2.3.11.02.iii	0.235
2.3.11.03a	0.124
2.3.12.02	0.089
2.5.05.02.iii	0.301

Portfolio Perspective or Coverage Check for all ITAAC

- For the baseline inspection program, a threshold of .4 was selected based on engineering judgment, to provide an adequate sampling of overall ITAAC activities.
- To ensure that all ITAAC families are inspected, matrix families with no ITAAC greater than the .4 threshold are inspected by selecting one ITAAC.
- Flexibility for NRC Region 2 to modify inspections, on a limited basis, to ensure the sample is representative of the total population.

Results

- For the AP-1000, 233/672 ITAAC were selected which is 35%.
- For the ABWR, 383/881 were selected which is 44%.
- Reviews are in process to determine resource levels needed to complete the baseline inspection program.
- Licensee performance is monitored as part of the assessment process and NRC can expand the selection of ITAAC samples based on poor performance.

Conclusion/Questions

- The baseline inspection program consists of ITAAC selected for direct NRC inspection using a defined prioritization process.
- The prioritization process optimizes NRC resources.
- Completion of this program will provide reasonable assurance that a significant construction or design translation error does not go undetected.