Digital I&C and Human Factors Industry Initiatives

December 21, 2006

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NEI

Topics

- **Common Goals**
- **Industry Thoughts**
- **Industry Organization**
- **Contents of Integrated Plan**
- **Priority Items List**
- **Moving Forward**
- **Near-Term Challenges**
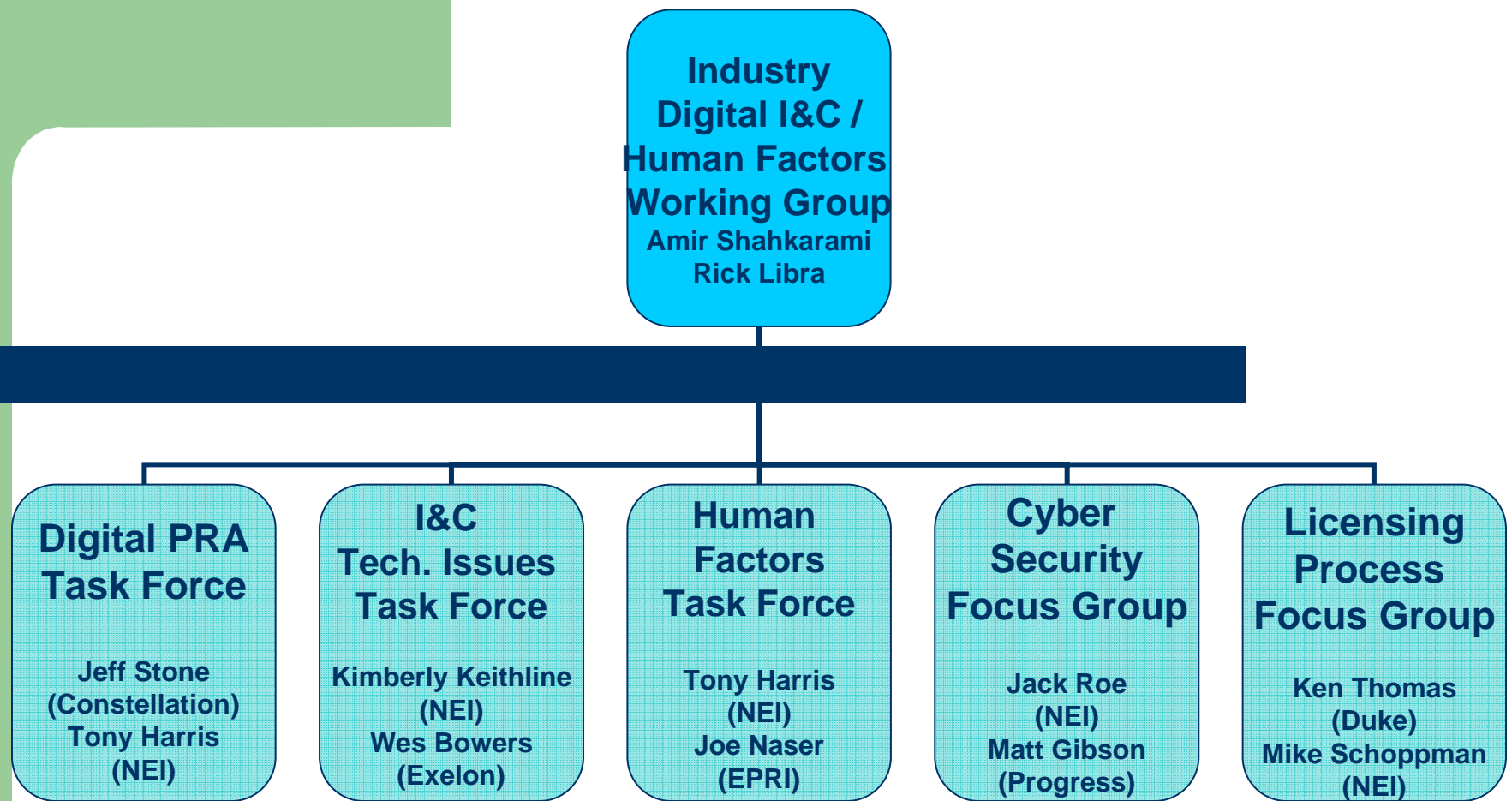
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Common Goals

- **A stable, predictable, and timely licensing process for both new and existing plants, evidenced by:**

    - Timely, generic resolution of emerging issues

    - Submittal of high quality license amendment requests, standardized to the extent possible

    - Using the right process when there is a need to take positions contrary to existing published guidance

    - Understanding that the application of mechanical system or analog design concepts to digital technology may not be the appropriate model

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Common Goals (con't.)

- **Integration of activities in and across multiple areas and organizations**
  - Human factors, I&C, cyber security, PRA, research
  - Industry, NRC, standards organizations, international organizations

- **Understanding of, agreement on, and, to extent possible, collaboration on research initiatives**

- **Use of risk insights to help us better understand system vulnerabilities and develop safer and more reliable digital designs**

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Industry Thoughts

- **Define resources (Industry & NRC) needed to develop action plans and coordinate issue resolution in a timely, efficient manner**
    - **Develop management and staff level communication protocol**
    - **Develop NRC/Industry Integrated Action Plan**
    - **Define research activity communication protocol**

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                    │    Industry      │
                    │  Digital I&C /   │
                    │  Human Factors   │
                    │  Working Group   │
                    │  Amir Shahkarami │
                    │    Rick Libra    │
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Digital PRA Task Force	I&C Tech. Issues Task Force	Human Factors Task Force	Cyber Security Focus Group	Licensing Process Focus Group
Jeff Stone (Constellation) Tony Harris (NEI)	Kimberly Keithline (NEI) Wes Bowers (Exelon)	Tony Harris (NEI) Joe Naser (EPRI)	Jack Roe (NEI) Matt Gibson (Progress)	Ken Thomas (Duke) Mike Schoppman (NEI)

The Industry Digital I&C and Human Factors Working Group, along with its associated Task Forces and Focus Groups, provides an infrastructure for industry and vendors to effectively interface with NRC and address potential generic issues that arise from the implementation of digital technology.

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Digital I&C / Human Factors Working Group

- Amir Shahkarami (Exelon)
- Rick Libra (DTE)
- Mitch Lucas (TXU)
- Kimberly Keithline (NEI)
- Tony Harris (NEI)
- Joe Naser (EPRI)
- Larry Erin (Westinghouse)
- Richard Miller (GE)
- Vic Fregonese (Areva)
- Ken Scarola (MHI)
- Bill Duge (FENOC)
- Bob Gambrill (INPO)

- Guy Cesare (NuStart)
- Robert Atkinson (Dominion)
- Ken Thomas (Duke)
- Wes Bowers (Exelon)
- Jay Amin (TXU)
- Warren Busch (FP&L)
- Jack Stringfellow (Southern)
- Ron Jarrett (TVA)
- Jim McQuighan (Constel.)
- Dave Hooten (Progress)
- Jean-Pierre Berger (EDF)
- Jamie LaBorde (SCANA)

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I&C Technical Issues Task Force

Coordinates industry efforts relative to I&C technical issues associated with the application of digital technology for both existing and new plants.

Human Factors Task Force

Coordinates human factors and control room design issues associated with use of digital technology for both existing and new plants.

Digital PRA Task Force

Coordinates industry efforts relative to the use of risk insights associated with digital technology for both existing and new plants. The group also reviews NRC research activities associated with digital applications.

Focus Groups

Coordinate with existing NEI task forces to address issues related to cyber security and the licensing process.

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Industry Steering Committee

- Subset of the Digital I&C / HF and the New Plant Working Groups
- Interface with NRC steering committee
- Committee Participants
  - Amir Shahkarami (Exelon)
  - Jay Thayer (NEI)
  - Alex Marion (NEI)
  - Rick Libra (Detroit Edison)
  - Chuck Welty (EPRI)
  - New Plant Working Group (TBD)

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Contents of Integrated Plan

- **Background**
- **Scope**
- **Responsibilities**
- **Interaction Protocol**
- **Research and Collaboration Protocol**
- **List of Priority Items**
  - **Deliverables**
  - **Schedules**
  - **Resources**

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Priority Items List

- Digital communications

- Diversity & Defense-in-depth / BTP-19

- New technologies (FPGAs)

- Cyber Security

- Licensing Process

- Risk-informing digital applications

- Technical Specifications Surveillance requirements

- Minimum Inventory

- Computer-based procedures

- SRP Updates

- DG-1145

- I&C and Human Factors Research Collaboration

- Coordination of various industry groups

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Moving Forward

- **Digital communications issues can be used as a model**
  - Issue agreement meeting
  - Draft Technical Paper developed
  - Meeting on Technical Paper
  - Comment resolution
  - Define regulatory process to be used
  - Formal submittal of Technical Paper
- **Short and long-term resolution paths**

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Near-Term Challenges

- Digital Communications – building on success to-date

- BTP-19 Update / SECY status

- Other SRP Updates (selected sections)

- Impact of Continuing Resolution

- Prioritizing Research activities – both in I&C and Human Factors

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NRC/INDUSTRY
INTEGRATED PROJECT PLAN

DIGITAL I&C AND HUMAN FACTORS

DRAFT

12/20/06

BACKGROUND

The use of digital technology in instrumentation and control (I&C) systems provides opportunities to apply technological advancements to nuclear power plants that will improve plant performance and reliability. New plants will use fully digital systems for control, communication and human-system interfaces (HSIs). As a result vendors, perspective licensees, and NRC staff will face challenges for which there is limited technical guidance and regulatory precedent. Extensive upgrades to existing plant I&C systems will likely experience similar challenges.

There are several unsettled technical and licensing issues in the areas of instrumentation and control (I&C), human factors (HF), and the related control room design that need coordinated, proactive industry and Nuclear Regulatory Commission (NRC) attention. The issues are unsettled in the sense that there is limited guidance and not always consensus among utilities, suppliers, and the NRC in regard to what solutions are technically appropriate and would be acceptable from a regulatory perspective. Some of these issues are causing protracted regulatory reviews for existing plants, and left untreated, they will likely cause substantial delays and increased costs for new plant combined construction and operating license (COL) approvals.

Industry and the NRC have roles in resolving the priority items and addressing them in future design efforts and regulatory reviews. This paper provides an integrated NRC / industry action plan, consistent with guidance provided to NRC staff in a December 6, 2006 Commission Memorandum that

1) defines currently identified priority items,

2) identifies actions needed to address these items, and

3) establishes an ongoing process to facilitate coordination between NRC and industry on resolving new issues as they are identified during research and revyiew efforts.

SCOPE

The scope of this initiative includes digital I&C and Human Factors issues and research associated with both new and existing plants, consistent with the scope outlined in:

- Standard Review Plan Chapter 7

- Standard Review Plan Chapter 18

Attachment 1 provides the current list of priority items. The Industry and NRC Steering Committees will be responsible for maintaining oversight of changes to scope and content of the issues being addressed. As potential generic issues are defined by either industry or the NRC staff, the NRC Steering Committee

and NEI Working Group will perform a review to ensure the issues are both applicable to the scope and purview of this effort.

RESPONSIBILITIES / ORGANIZATION

Nuclear Energy Institute (NEI) has formed a working group and several task forces to coordinate industry efforts and communications with NRC staff. The working group will also help determine priorities and coordinate both new and existing plant resources. EPRI and the four main new reactor vendors are represented on the working group. The working group has divided the work among three task forces, each of which will be assigned as the lead on specific issues.

NRC has developed a Steering Committee to interface with the industry and provide oversight of digital I&C and related human factors issues. Deputy Director level positions and above from the key NRC organizations are represented on this Steering Committee.

The industry and NRC steering committees will jointly meet, on a periodic basis, to ensure maintenance and implementation of this plan. This plan is expected to be updated on a periodic basis to reflect new priorities and status ongoing efforts.

INTERACTION PROTOCOL

Communications are expected to occur at multiple levels: 1) Periodic Commission Briefings; 2) NRC and Industry Steering Committee interactions, and 3) NRC staff and task force level interactions.

Commission Briefings
A Commission briefing will be held in June 2007 to provide a progress report on the integrated plan, consistent with direction provided in the December 6, 2006 Commission memorandum.   Further briefings will be held as the need is determined.

Steering Committee Meetings
The NRC and Industry Steering Committees will meet monthly beginning December 2006 until June 2007. At that point, it is expected that the meetings can be moved to a quarterly frequency.

Technical Level Interactions
Frequency of interactions at the technical levels will be addressed in specific issues in this plan in the form of public meetings. In general, the meetings will be coordinated among the various NRC branches and the industry task forces that have responsibility for the issues. NEI will provide coordination for industry participation.

Website
To further facilitate communication, the NRC staff is developing a public website to provide information relative to ongoing initiatives in the digital I&C and human factors areas. Updates to this plan will be posted on the website.

Technical Disagreements
The overall objective of this interaction protocol is to provide a means of achieving consensus on issues and appropriate means to resolve these issues. It is recognized that technical disagreements on issues or processes may arise during interactions. The NRC and Industry Steering Committees provides a forum for resolving differences that may arise which affect resolution and/or closure of priority items in this plan.

RESEARCH AND COLLABORATION PROTOCOL

Research activities in the areas of digital I&C and related human factors issues are being conducted by many industry and government agencies, in the United States and abroad. For example, NRC Digital System Research Plan for FY 2005 - 2009 is a flexible, adaptable framework with a number of research initiatives. The plan contains 27 projects across 6 Research Programs (ML061150050). Commission direction, provided in the December 6 memorandum, called for the NRC staff to establish short term priorities for conducting research and revising regulatory guidance in light of resource restrictions imposed by Continuing Budget Resolutions, and seek industry comment on these priorities. The memorandum also noted that collaboration between industry and NRC staff on these efforts will be undertaken where possible.

EPRI, NEI, and NRC staff will meet on a quarterly basis to coordinate and review research efforts such that research is done in as effective and efficient a manner as possible, with appropriate priority. Any future research initiated by one of these groups will be reviewed with the Industry and NRC Steering Committees prior to the projects beginning to ensure that 1) reasons for the research are clearly understood, 2) goals and deliverables are defined, and 3) collaboration opportunities are explored.

ISSUES AND PRIORITIES

The goals of this plan are to 1) ensure that regulatory issues associated with digital upgrades and new plant designs are resolved in a timely manner, and 2) that clear regulatory guidance is provided to licensees and NRC staff. A list of the current priority items includes:

- Digital communications
- Diversity & Defense-in-depth
- New technologies

- Minimum Inventory
- Computer-based procedures
- Risk-informing digital applications
- SRP Updates
- DG-1145
- Cyber Security
- Licensing Process
- Technical Specifications Surveillance Credit
- Coordination of various industry groups
- I&C and Human Factors Research Collaboration, including Human Factors issues arising from advanced control room designs

Attachment 1 provides a description and proposed action plan for each of the above items. The staff and industry will define the deliverables, schedule, and resources needed to resolve the items and develop a mechanism to ensure consistent regulatory application of NRC guidance by both the licensees and NRC staff.

The Steering Committee and industry committee will monitor progress against the schedules and deliverables defined in this plan.

It is estimated that nine or more combined license applications may be submitted to the NRC in FY2007 and FY 2008. If new plants are to be successfully licensed in a timely, cost-effective manner, the industry and the NRC need to move forward now to develop effective, generic solutions that can be applied before individual plant COL applications are submitted. In addition, new plant representatives have indicated that Control Room simulators must be ordered prior to 2010 to be successful in meeting targeted completion dates. Issues must be appropriately prioritized to ensure that these dates can be met.

In addition, many existing plants are developing strategies to modify their plants to take advantage of more integrated digital control and protection systems and address obsolescence issues. Lack of resolution of the priority items will likely delay the benefits and improvements provided by these technologies for existing plants.

REFERENCES

- SRM 061108, December 6, 2006

- NRC Research Plan (ML061150050)

- NRC Standard Review Plan (NUREG-0800)

ATTACHMENT 1							
NRC / INDUSTRY INTEGRATED PROJECT PLAN PRIORITY ITEMS LIST							
PRIORITY ITEM	INDUSTRY LEAD	NRC LEAD	ACTIONS NEEDED / DELIVERABLES	SCHEDULE	PRIORITY	STATUS	ORGANIZATIONS / RESOURCES
Digital Communications: With digital technology, judicious communication between redundant safety divisions and between safety and non-safety systems can provide reliability and safety enhancements. Need to establish clear requirements and acceptance criteria whereby such communication can be designed and utilized.	Wes Bowers Kim Keithline		Digital Communications: • Meet with NRC staff to develop an adequate characterization of the communications issue. • Industry develops a draft white paper that will provide a basis for understanding and develop options to address the communications issues. • Industry provides the draft white paper to NRC staff. • Industry meets with NRC staff to discuss white paper, near-term NRC actions, and priority of research efforts relative to this issue. • NRC and industry agree on collaboration associated with NRC Research plan. • NEI submit suggestions for SRP 7.1-D based on shared vision for communications. • NRC considers NEI suggestions for SRP 7.1-D and issue draft for industry review. • NRC issue SRP 7.1-D for use and comment. • NEI and NRC representatives meet with IEEE SC-6.4 to discuss shared vision and required changes to IEEE 7-4.3.2. • NEI draft technical document on communications issues. NRC provides input through review of drafts. • NEI provide technical document to NRC. • NRC incorporates industry input into NUREG/CR. • IEEE draft revisions to IEEE 7-4.3.2. • IEEE approves revised IEEE 7-4.3.2. • NRC issues draft of revised RG-1.152. • NRC issues revised RG-1.152 endorsing IEEE 7-4.3.2.	10/19/06 12/1/06 12/5/06 12/12/06 12/12/06 1/5/07 TBD 3/31/07 1/22/07 Feb. and Mar. 2007 3/30/07 7/1/07 Jan. – July 2007 1/31/08 3/1/08 9/1/08	High	Complete Complete Complete Complete	NEI I&C Technical Issues Task Force NRC I&C Branch NRC Research I&C Branch
Diversity and Defense in Depth: Update and improve guidance for Diversity and Defense-in-Depth (D3)	Jerry Mauck Kim Keithline		Phase 1: Near-term BTP-19 Update • NRC provides revised BTP-19 for industry review and comment. • Industry provides draft white paper to NRC.	1/4/07 1/26/07	High	Industry has requested opportunity to engage on staff proposed changes prior to SECY being sent to	NEI I&C Technical Issues Task Force NRC I&C Branch

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evaluations.			• Industry and NRC meet to discuss D3 issues, including potential changes to BTP-19. • Industry provides comments to NRC on revised BTP-19. • NRC issue revised BTP-19 for use and comment. Phase 2: Provide improved D3 guidance (Revision or second volume to NUREG/CR-6303) • Industry meets with NRC Research and contractor (ORNL) to discuss plans and objectives. • Industry review pilot study white paper. • Industry provides first draft of pilot study white paper to NRC. • Industry completes draft of industry guideline. • Industry completes second draft of pilot study, incorporating feedback from NRC and draft industry guideline. • Industry s submits pilot study to NRC. • NRC provides draft NUREG for comment. • Industry provides comments on draft NUREG. • Complete review of industry guideline and incorporate comments. • Publish industry guideline.	2/2/07 2/16/07 3/31/07 2/2/07 TBD TBD TBD TBD TBD TBD TBD TBD TBD		Commission.	NRC Research I&C Branch
New Technologies: Research is needed to ensure consistent implementation of new digital I&C technologies.	Kim Keithline Tony Harris		• Wolf Creek complete FPGA collaborative research with NRC. • Identify need for additional research related to new technologies. • Develop plans for completing additional research	August 2007 March 2007 March 2007	Medium	FPGA work in progress.	NEI I&C Technical Issues Task Force NRC I&C Branch NRC Research I&C Branch
DG-1145 - Develop guidance for COLAs.	Tony Harris Kim Keithline Bob Fuld Wes Bowers		• Identify group responsible for leading I&C and Human Factors industry efforts. • Review DG-1145 preliminary and final drafts and provide comments to NRC staff.	Complete	High	Complete. The New Plant Task Force requested the I&C and Human Factors WG to oversee Chapters 7 and 18 of DG1145 and SRP. Kimberly Keithline is Chapter 7 lead;	NEI I&C/HF WG

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						Tony H. & Bob Fuld (W) are Chapter 18 leads (Human Factors). Comments submitted on both preliminary and final drafts.	
Existing guidance for establishing minimum inventory of spatially dedicated, continuously visible HSIs and for defining controls on computer based procedures needs to be improved. In addition, other potential issues, such as use of soft controls, automation, graded approach to application of HFE, and role of the operator need to be further discussed to understand whether additional guidance may be needed in these areas.	Tony Harris Bob Fuld Joe Naser		As a result of the October 19, 2006 meeting, the following actions have been identified: • Industry provides to NRC staff technical paper on "minimum inventory" of instrumentation and controls concept and a process for identifying MI. • Industry provides technical paper on "computer based procedure systems." • NRC staff to publish Technical Report on human factors issues in new and advanced reactors for public comment. • Industry to participate on NRC panel that will be performing a PIRT analysis with a goal of identifying and prioritizing research efforts at NRC and possible industry collaboration opportunities. • NRC completes review of industry technical papers.	Feb 2007 March 2007 February 2007 Feb 2007 April 2007	High	EPRI developed control room human factors guidelines document that was published in December 2005 and which will provide the basis for continuing work in this area.	NEI Human Factors Task Force EPRI interface support needed. Also needed for development of technical papers. NRC Human Factors Branch NRC Human Factors Research
Cyber Security – Develop an integrated, consistent, and coherent approach to cyber security requirements and guidance for power reactors.	Jack Roe Matt Gibson		• Have discussion with NRC to clarify what the NEI/industry letter will address in mid-December • NEI submit white paper to NRC regarding NEI 04-04 and Reg Guide 1.152, Rev. 2	Dec. 1, 2006 Dec. 15, 2006	High	Meeting held October 19, 2006; discussions continuing.	NEI Cyber Security Task Force NEI I&C/JF WG
SRP Updates: NRC staff is updating the SRP for use by new plants. Staff indicated that updated information would be applicable to both new and existing plants. NOTE: NRC initial plans were to submit drafts of certain Chapter 7 sections; however, none have been provided to date.	Tony Harris Kim Keithline		I&C and HF Working Group monitor changes to Chapters 7 and 18 as they are released. • Review and comment on DG-1142 • Participate in NRC workshop on DG-1142 • NRC staff issues SRP update for "review and comment")	 Complete Complete March 2007	High	NRC held public meeting May 2006. Revised NRC Staff plan mandates all SRP sections be updated by March 2007. This has changed from the March 2006 EPRI workshop and is causing resource issues for staff. Given the compressed schedule, the staff plans to merely incorporate existing guidance documents into the update, and does not plan on	NEI HF/I&C WG

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						addressing any of the issues from the 3/06 workshop.	
Risk-Informed Regulatory Review: No risk insights are being utilized in digital I&C designs. NRC RES has developed a "Digital System Risk Research Program." Purpose of research plan is to investigate methods for including reliability models for digital systems into PRAs, integrate models into agency tools, and develop regulatory guidance. As a part of that program, NRC RES is developing a Regulatory Guide and supporting technical documents. The goal of this item is to ensure industry collaboration and insights into the ongoing research activities.	Tony Harris Jeff Stone		o A teleconference with industry participants was held on July 6, 2006 to discuss results of the ACRS meeting and path forward. The group of individuals from each vendor, EPRI, and a utility to prioritize for issues and develop a schedule for resolution. o Complete Peer Review of NUREG/CR-XXXX "Reliability Modeling of Digital Instrumentation and Control Systems" o Meet with NRC research to discuss other elements of their research plan and possible areas of collaboration, including plans to develop a Draft Reg Guide on Risk Informing Digital I&C Reviews.	Complete January 2007 March 2007	Medium	RES presented Digital System Risk Research program to ACRS I&C Subcommittee on 6/27. Industry proposed, and ACRS and RES agreed that collaboration and peer review of NRC research products would be beneficial. Industry peer reviewers identified to NRC. NEI proposes to have a meeting with NRC research to discuss collaboration and peer review opportunities.	NEI Digital PRA Task Force NEI PRA Applications Task Force EPRI support needed relative to review of documents and general task force support.
Define an orderly licensing process for digital I&C systems and Advanced HSI based on the defined phases of the plant system design and implementation process.	Ken Thomas M. Schoppman Jim Fisicaro		• Industry will develop a paper that outlines a review process to streamline the licensing of digital upgrades. The paper will be coordinated with the new plant process to share experience and ensure processes (i.e., licensing versus inspection or audit) are similar to the extent possible. Issue is being worked in conjunction with a revision to the License Amendment process for FOAK submittals. • Once the process is completed, NEI 01-01, Licensing Guideline for Digital Upgrades, will be reviewed for possible update. Detailed project plan is as follows: 1. Information Gathering: a. Poll the industry to find any existing procedures that utilities use to develop FOAK projects. 2. Brainstorming Meeting:	11/08/06: FOAK Team Telecom 11/30/06: Poll industry for FOAK inputs 12/12/06: FOAK Team meeting at NEI (White Paper kickoff) Dec06-Jan07: Develop a 1st draft White Paper Feb07: FOAK Team meeting at NEI to discuss 1st draft WP	MEDIUM	Group formed, project plan developed and is in review. On schedule.	NEI Licensing Actions Task Force NEI Digital I&C and HF Working Group NRR Projects NRR Tech Specs branch

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			a. Determine what constitutes an FOAK item (e.g., types, specific boundaries, limitations, categories, etc.). b. Determine the regulatory "finding" that NRC must make to approve an FOAK request. c. Determine the range of regulatory requirements and guidance that would apply to an FOAK item (statutes, regulations, orders, NUREGs, Office Instructions, generic correspondence, etc.). d. Determine the standards relevant to an FOAK item (e.g., SRP, Reg. Guides, industry codes & standards, etc.) e. Determine the industry guidance that exists or needs to be developed for an FOAK f. Define desired outcomes (licensing strategy; use of risk information; etc.). g. Document key terms and definitions. 3. Process Mapping: a. Develop a process map of the License Amendment Request (LAR) process. b. Develop a process map of the work breakdown structure and flowchart for a FOAK item. c. Develop a process map of the plant modification process to determine when deliverables need to be available at each stage of the process. d. Overlay the FOAK Map and the Modification Map to define a phased implementation schedule; use as input to regulatory strategy and financial risk management. 4. Communications Plan a. Management sponsor b. Industry communications c. NRC communications d. Talking points e. Meeting protocol f. Dispute resolution protocol 5. NEI White Paper or Guideline a. Document the FOAK process	Mar07-Apr07: Process-mapping phase May07: FOAK Team meeting at NEI to incorporate process maps into the WP May07-Jun07: Develop final draft WP Jul07-Aug07 Obtain industry comments on WP Sep07: Final Team meeting and submit WP to NRC Oct07: NEI Licensing Forum After Oct07: Meet as needed with NRC to facilitate regulatory review After Oct07: Begin review of NEI 01-01 to identify possible changes.			

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			b. Submit for NRC endorsement				
Technical Specification surveillances: Identify generic capabilities of digital systems, and establish what is reasonable with respect to optimize surveillance requirements (e.g., minimize channel checks).	Tony Harris		Look at tech spec changes for increasing the calibration interval for safety instruments to see what can support this. Discuss with vendors where they see need for tech spec changes to take advantage of the capabilities of digital equipment. Discuss with utilities what capabilities they want that will require tech spec changes. Work with vendors to develop a common approach to tech spec changes. No plans currently exist within the TS Task Force to address this issue.	TBD	Medium	Not Started.	OG TSTF (for TS improvements) NEI I&C/HF WG (for ISA std) NEI SMTF (for setpoint issue) NRR TS Branch
Identify and coordinate industry and regulatory working groups, in the US and abroad, associated with digital I&C and Human Factors.	Kim Keithline		Draft list of groups, update NEI 05-08.	April 17, 2007	Medium	Initial draft in progress.	