TWG #4: HIGHLY-INTEGRATED CONTROL ROOM—COMMUNICATIONS

1. BACKGROUND:

The Highly Integrated Control Room-Communications Issues (HICRc) Task Working Group (TWG) will address HICR design issues related to communications involving digital equipment in nuclear safety service. This action is needed to support development of the design and procurement specification for simulators for new plants and for the design and implementation of digital retrofits at existing plants. Specifically, this TWG will address all communication design provisions between safety divisions[1], and between safety and non safety divisions. In this context, "communication" means any transmittal or reception of data, information, or commands.

There are clear potential advantages to the implementation of some types of cross-divisional communication within digital systems. However, preservation of adequate independence for digital systems communications is essential. The objective of this task working group is to evaluate cross-divisional communication interactions and to clarify design and licensing criteria by which beneficial interactions may be accomplished while maintaining adequate safety margin.

2. SCOPE:

The following types of communication interactions will be addressed by the TWG:

a. Communication among redundant electrical divisions
b. Communication between any safety channel and anything external to that division
c. Control of safety equipment in multiple divisions from a single workstation
d. Control of safety equipment from a nonsafety workstation
e. Commingling of safety and nonsafety controls or indications on a single workstation
f. Connection of nonsafety programming, maintenance, and test equipment to redundant safety divisions during operation

The following are explicitly excluded from the scope of this task:

g. Communication within a single safety division
h. Communications which do not involve a safety channel

Cyber-Security, Diversity and Defense-in-Depth, and Human Factors (HF) considerations are all closely related to the general concept of cross-divisional communications. However, these issues are being addressed by other TWGs.

[1] The terms "channel" and "division" are used herein in accordance with the definitions of those terms in IEEE 603-1991.

Therefore coordination with each associated TWG will be necessary to ensure that HICRc TWG activities are consistent with, and supportive of, the solutions that they will provide.

Except as specifically addressed in the resolution of the issues identified above, physical separation and electrical isolation requirements for digital equipment are the same as for non-digital equipment. Physical separation and electrical isolation will not be addressed separately in this task. Similarly, seismic and environmental qualification requirements are not included in this task.

3. PROBLEM STATEMENT:

Industry and NRC guidance documents do not define at a sufficient level of detail the expectation for inter-divisional communications independence.

a. Industry Standards (e.g. IEEE 7-4.3.2-2003, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations") do not provide sufficient guidance for inter-divisional communications independence within digital systems.

b. NRC regulatory guidance (e.g. Regulatory Guide 1.152, "Criteria for Digital Computers in Safety Systems of Nuclear Power Plants") does not provide explicit guidance for inter-divisional communications independence within digital systems.

c. The protection system division separation and isolation requirements in existing regulations (10CFR50.55a (h),"Protection and Safety Systems," which incorporates IEEE603-1991, "Criteria for Safety Systems for Nuclear Power Generating Stations," among other things) does not define for digital systems "the degree [of independence] necessary to retain the capability to accomplish the safety function during and following any design basis event requiring that safety function."

d. Standard Review Plan Chapter 7 includes conflicting guidance regarding communication independence.

4. DELIVERABLES:

a. Issue interim guidance that will document an acceptable degree of communications independence for digital systems.

b. Facilitate a revision to IEEE 7-4.3.2.

c. Revise Regulatory Guide 1.152.

d. Update the Standard Review Plan guidance to provide acceptable regulatory and

licensing criteria for communications independence of digital systems.

5. DISCUSSION:

The TWG will consider the possibility that the needs of new and existing facilities are different, and will include accommodation of such differences in the guidance documentation if necessary. It is initially anticipated that there will be no difference in the guidance for new and existing facilities.

Final guidance relating to control room design is needed to support final specification and design of the simulators for new plants. It is anticipated that the first simulators will need to be ordered in mid-2009, and that about 18 months will be required between the time the guidance is issued and the first simulators are ordered. The guidance is therefore needed by early 2008. To allow for a reasonable amount of schedule float, the TWG anticipates completing its work in mid-2007.

It is noted that support of simulator procurement requires only that the conceptual design of the control room be completed. It does not require that the details of the internal workings of the operator interfaces be fully developed. The efforts of this TWG will influence the nature and layout of the control room in that requirements relating to the disposition and application of operator interface workstations could be affected, but those influences will be limited to whether various operator-interface design provisions will or will not be considered acceptable (for example, whether or under what design constraints it might be acceptable for a single control station to include both safety and nonsafety functions). The efforts of other TWG will have greater influence upon control room design and layout, such as the TWG working on Diversity and Defense-in-Depth (D3) requirements, and the TWG working on details of Human-Machine Interfaces (HMI) from a Human Factors (HF) standpoint.

In the near term (defined as in support of simulator procurement for the first of the anticipated new plants), the TWG will produce guidelines describing appropriate design provisions and limitations. These guidelines will include a statement of the fundamental requirements and specific regulatory criteria that must be observed. The HICRc TWG will also provide recommendations for revisions to RG1.152, IEEE 7-4.3.2, applicable Standard Review plan sections, and other regulatory guidance and industry standards as deemed necessary.

The TWG will give due consideration to the burdens (e.g., costs, labor) that might be imposed upon both applicants and NRC staff as a result of specific guidance. For example, acceptance of a certain provision might require detailed staff review in an area not presently subject to such review. This would impose a burden upon an applicant in that additional materials must be assembled for inclusion in the application package, some of which may be proprietary and thus require the development of a redacted version as well as the full version, and upon the NRC in the actual review of the subject details. The cost of such a provision in terms of resources, review effort, and review time extension should be considered in relation to the potential benefits of such an approach relative to an approach that is simpler from a regulatory point of view.

In addition, it is anticipated that the TWG will make all reasonable efforts to provide guidance that will not involve significant changes in NRC policy and will not require rulemaking. It is anticipated that industry objectives can be met within the existing regulations.

6. CRITICAL PATH AND STEPS TO SUCCESS:

In order to accomplish its mission, the HICRc TWG may need to have timely access to detailed information concerning proposed reactor designs. The TWG will make every reasonable effort to obtain specific design information needed to support its work, relying principally upon the efforts of the industry contacts assigned by NEI. However, if extended correspondence with reactor vendors is required in an effort to obtain the needed information, or if information availability is restricted by intellectual property rights issues or other issues, the TWG may recommend deferral of review of the respective designs until such design details are made available, or recommend other compensatory action to the NRC Digital I&C Steering Committee. In such a case, the TWG would proceed on the basis of generic considerations. The NRC Digital I&C Steering Committee should be advised promptly if such a situation occurs.

The primary efforts of the TWG will include the following:

a. Develop a statement describing the existing regulatory requirements and regulatory guidance associated with cross-divisional interactions, without consideration of specific proposed designs. This statement will establish the fundamental restrictions and requirements, or boundaries, for the ultimate products of the HICRc TWG.

b. Develop a detailed and prioritized listing of the design concepts to be considered by the TWG. The TWG will address the associated design and licensing issues in accordance with this prioritization. To support the development and prioritization of this listing, the TWG will request that the industry contacts provide their collective best estimate of the types of cross-channel interactions that have actually been proposed or planned, with indication of the level of interest in the use of each type. Consideration should include new plants, existing plants, and fuel cycle facilities. The objective of this advice is to ensure that the TWG addresses the types of interactions that are of greatest interest to industry. For example, perhaps many system designers plan to use scratchpad-based data exchange and some but very few plan to use Ethernet-based direct communication between safety processors: then the TWG would address the more widespread practice first and the less widespread practice later. If it determines that some type of interaction is planned for use by only a very few suppliers but that type of interaction is highly desirable or problematical, the TWG may choose to address that issue early in order to get the word out that type of interaction may be easy or difficult to license.[2]

[2] This prioritization will not preclude or affect NRC consideration of interactions proposed in license requests that have already been submitted or that are submitted in the future.

c. Obtain preliminary results of the on-going NRC/RES research project concerning communications issues regarding highly-integrated control rooms. This research is exploring similar issues in other countries, and it is expected that the results may be useful to this TWG.

d. Develop a list of regulatory and design requirements applicable to each type of interaction. Include the basis for each requirement.

e. Develop a draft annotated outline for the guidance document(s), including draft acceptance criteria for each item.

f. Industry (via NEI) review and comment on the draft outline and proposed acceptance criteria.

g. Develop detailed guidance recommendations to be implemented in the interim guidance document(s).

h. Develop regulatory and design guidance document(s) addressing communications independence for digital systems. The guidance should include specific acceptance criteria for types of interactions found to be acceptable, and should also include descriptions of types of interactions found to be unacceptable.

License requests that fall outside the recommendations of the TWG or that are contrary to them will be considered by the NRC on a case-by-case basis.

7. MILESTONES, ASSIGNMENTS, AND DELIVERABLES:

Milestones, Assignments and Deliverables	Deliverable	Due date	Fcst/Actual	Lead	Support
NEAR-TERM					
Problem 1: Communications Independence					
Receive industry proposals for HICR communication design concepts	✓	Jun 1	A	NEI	n/a
Identify regulatory & design requirements with basis for each type of interaction		Jun 22	F	NRC	NEI
Issue draft interim guidance	✓	Aug 10	F	NRC	n/a
Discuss draft interim guidance in public meeting		Aug 14	F	NRC	NEI
Receive public comments		Aug 22	F	NRC	n/a
Issue interim guidance as appropriate	✓	Sep 28	F	NRC	n/a
LONG-TERM					
Problem 1: Communications Independence					
Work with IEEE on modifications to 7-4.3.2 and issue	✓	TBD	F	NEI	NRC
Develop RG 1.152 revision		TBD	F	NRC	n/a
Develop SRP revision		TBD	F	NRC	n/a
ACRS Interaction (as needed)		TBD	F	NRC	n/a
CRGR Interaction (as needed)		TBD	F	NRC	n/a

Milestones, Assignments and Deliverables	Deliverable	Due date	Fcst/Actual	Lead	Support
Issue revised RG 1.152	✓	TBD	F	NRC	n/a
Issue revised SRP	✓	TBD	F	NRC	n/a