TRISO-X, LLC
801 Thompson Avenue
Rockville, MD 20852
+1 301.358.5600

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July 28, 2023

Director, Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

References:
1) Docket No. 70-7027
2) TRISO-X letter from Jennifer Wheeler to Director, Office of Nuclear Material Safety and Safeguards, "TRISO-X Fuel Fabrication Facility License Application Submittal," dated April 5, 2022
3) NRC letter from Matthew Bartlett, Senior Project Manager, Fuel Facility Licensing Branch, to Jennifer K. Wheeler, "Request for Additional Information (Set 1) for the TRISO-X, LLC License Application for a Fuel Fabrication Facility (Enterprise Project Identification Number L-2022-NEW-0005)," dated May 31, 2023

Subject: **Response to Request for Additional Information (Set 1) for the TRISO-X, LLC License Application for a Fuel Fabrication Facility**

TRISO-X, LLC (TRISO-X) hereby submits responses to the subject Request for Additional Information (RAI), regarding the review of the License Application for the TRISO-X Fuel Fabrication Facility (Reference 2). The enclosed responses are for the RAI set transmitted by letter dated May 31, 2023 (Reference 3).

An evaluation supporting the response to RAI 3-2 *Evaluation for Local Intense Precipitation* is still in-process. TRISO-X will submit this response to the NRC by August 18, 2023.

Requests for Withholding

None. The enclosed submittal contains public information.

Summary of this Submittal

The following Enclosure and Attachment are included with this letter.

Enclosure – Response to Request for Additional Information (Set 1)

Attachment – TRISO-X Human Factors Engineering Plan

If there are questions or if additional information is required, please contact me at (865) 850-0893 or jwheeler@triso-x.com.

Sincerely,

Jennifer Wheeler

Jennifer K. Wheeler, P.E.
Vice President, Regulatory Affairs

TRISO-X, LLC
801 Thompson Avenue
Rockville, MD 20852

Copy: Mr. Matthew Bartlett, US NRC, NMSS
TRISO-X Regulatory Records File

This enclosure contains responses to the following requests for additional information (RAIs):

1. Quality Assurance and Management Measures – Part 1 (5 RAIs)
2. Human Factors Engineering – Part 1 (1 RAI)
3. Structural – Part 1 (2 RAIs)

1. QUALITY ASSURANCE AND MANAGEMENT MEASURES – PART 1

RAI 1-1 – Construction Qualifications:

Regulatory Basis:

The regulations in title 10 of the *Code of Federal Regulations* (10 CFR) 70.22(a)(6), 70.23(a)(2), and 70.62(d) require a management system and administrative procedures for the effective implementation of health, safety, and environment functions concerning the applicant's corporate organization, qualifications of the staff, and adequacy of the proposed equipment, facilities, and procedures to provide adequate safety for workers, the public, and the environment.

Guidance for meeting these requirements can be found in NUREG-1520, Revision 2, "Standard Review Plan for Fuel Cycle Facilities License Applications," Chapter 2, Section 2.4.3(A). NUREG-1520, Revision 2, Chapter 11, "Management Measures," also provides guidance on this topic.

Description of Issue:

Chapter 2, "ORGANIZATION AND ADMINISTRATION", Section 2.3, "Organizational Responsibilities, Authority, and Qualifications," of the TRISO-X License Application (LA) only mentions construction activities as a responsibility of the engineering discipline. The outlined organizational positions and disciplines do not include the need to have training, qualification, or experience in executing construction projects.

Information Needed:

Please provide additional detail on organizational roles and responsibilities (e.g., Plant Manager, Regulatory Affairs, Quality Assurance) during the construction phase of the facility. Also, discuss any special qualifications or experience that may be required for each discipline participating in the construction phase.

TRISO-X Response:

LA Section 2.6 presents responsibilities for the transition from design and construction to operations. The TRISO-X organization is responsible for the construction and commissioning of the facility and equipment, including modifications in the future, using written plans and procedures. For initial facility construction, an architect/engineering (A/E) firm has been contracted to specify facility structures and systems, as well as to ensure the design meets applicable U.S. codes and standards. During the construction phase, construction activities and preparation of construction documents are completed using qualified contractors. TRISO-X oversight of the A/E and construction contracts may involve one or more functions as described in LA Section 2.3, depending on the scope of the design or construction activity. If a construction oversight function is used in addition to oversight provided by the engineering functions, the minimum qualifications required are the same as those for an individual responsible for engineering function(s) as stated in LA Section 2.3.3.

References

None.

License Application Changes

LA Section 2.6 “Transition from Design and Construction to Operations” will be revised as follows:

> **2.6 Transition from Design ~~and to~~ Construction to Operations**
> The TRISO-X organization as described in Section 2.3 is also responsible for planning, organizing, and overseeing the construction, installation, initial testing and commissioning of the facility and equipment, including modifications in the future, using written plans and procedures.
>
> For initial facility construction, an architect/engineering (A/E) firm has been contracted to specify facility structures and systems, as well as to ensure the design meets applicable U.S. codes and standards. During the construction phase, construction activities and preparation of construction documents are completed using qualified contractors. TRISO-X oversight of the A/E and construction contracts may involve one or more functions as described in Section 2.3, depending on the scope of the design or construction activity. If a construction oversight function is used in addition to oversight provided by the engineering functions, the minimum qualifications required are the same as those for an individual responsible for engineering function(s) as stated in Section 2.3.3.
>
> As the construction of systems is completed, they undergo functional and acceptance testing, as appropriate, as contained in approved procedures. Following successful completion of testing and commissioning, detailed transition plans and operational readiness reviews are used to confirm the equipment in each process area is functionally tested and ready to operate, and the assigned staff is trained and ready to commence operations when authorized to do so.
>
> The turnover will include physical systems and corresponding design information and records. Following turnover, the manufacturing organization will be responsible for system maintenance and configuration control. The design basis is maintained following the configuration management system described in Chapter 11, “Management Measures”.

RAI 1-2 – Quality Standards for IROFS

Regulatory Basis:

The 10 CFR 70.64(a)(1) states, “Quality standards and records. The design must be developed and implemented in accordance with management measures, to provide adequate assurance that IROFS will be available and reliable to perform their function when needed. Appropriate records of these items must be maintained by or under the control of the licensee throughout the life of the facility.”

Description of Issue:

The LA does not include a commitment to established quality standards or describe how they would be applied to items relied on for safety during facility construction or operations.

Information Needed:

Provide a comprehensive list of all quality standards that will be utilized and describe how each will be applied to items relied on for safety (IROFS). Include details on any published standards that TRISO-X intends to implement that are applicable to the

maintenance of quality records relating to IROFS that ensure adherence to the retention period specified in 10 CFR 70.64(a)(1).

TRISO-X Response:
TRISO-X implements a Quality Program consistent with elements 4-8 and 10 of ISO 9001:2015. ISO 9001:2015 is referenced in the LA Sections 2.3.5 and 11.8.2. Section 11.8.2 states that ISO 9001:2015 is the basis of the quality program and the application of controls are graded based on the item's importance to safety.

During the design process, individual requirements for IROFS components are defined and the equipment is individually graded and assessed to assign programmatic controls appropriate to the item's safety function. At this stage in the design process, ISO 9001:2015 guidance is applicable.

NUREG-1520 states that for Quality Assurance (QA) Records, QA records and records management systems may be used in lieu of or in conjunction with each other. In either case, the applicant should describe the methods used to document, prepare, maintain, and manage records, including records associated with IROFS. TRISO-X uses a records management system and describes the required information in the LA Section 11.7, Records Management; Section 11.1.2, Design Requirements; Section 11.1.3, Document Control; and Section 11.8.17, Quality Assurance Records. Specifically, LA Section 11.1.2 commits to addressing the baseline design criteria identified in 10 CFR 70.64(a) for IROFS, which includes the retention period specified for quality standards and records.

References
None.

License Application Changes
None.

RAI 1-3 – IROFS Basic Components

Regulatory Basis:
10 CFR 21.3(3) states, "When applied to other facilities and other activities licensed under 10 CFR parts 30, 40, 50 (other than nuclear powerplants), 60, 61, 63, 70, 71, or 72 of this chapter, basic component means a structure, system, or component, or part thereof, that affects their safety function, that is directly procured by the licensee of a facility or activity subject to the regulations in this part and in which a defect or failure to comply with any applicable regulation in this chapter, order, or license issued by the Commission could create a substantial safety hazard."

Description of Issue:
The LA does not identify which IROFS are considered basic components. The LA also has insufficient detail on how TRISO-X will comply with the requirements of 10 CFR 21, "Reporting of Defects and Noncompliance."

Information Needed:
Identify which IROFS (if any) are considered basic components as defined in 10 CFR 21.3(3). Describe how TRISO-X will adhere to all the requirements of 10 CFR 21. At a minimum, provide the following aspects of the 10 CFR 21 program: (1) procurement processes, (2) dedication processes, and (3) reporting processes.

TRISO-X Response:
No IROFS are considered basic components as defined in 10 CFR 21.3(3). Therefore, TRISO-X does not have applicability to 10 CFR 21 for the procurement, dedication, and reporting processes.

References
None.

License Application Changes
None.

RAI 1-4 – Quality Assurance Elements for IROFS

Regulatory Basis:
In accordance with 10 CFR 70.62(d), each applicant must establish management measures to ensure that IROFS, as documented in the Integrated Safety Analysis (ISA) Summary, provide reasonable assurance that they will be designed, implemented, and maintained in such a way as to ensure that they are available and reliable to perform their intended functions, when needed, to comply with the performance requirements of 10 CFR 70.61. The degree to which measures are applied may be a function of the item's importance in meeting the performance requirements.

NUREG-1520, Revision 2, Chapter 11, "Management Measures," gives examples of how "the other QA elements" portion of a management measures program may be applied in a graded manner. NUREG-1520, Revision 2, discusses how certain elements are amenable to being applied in that way and identifies these elements as: (1) QA program; (2) Design Control; (3) Procurement Document Control; (4) Instructions, Procedures, and Drawings; (5) Document Control; (6) Control of Purchased, Material, Equipment, and Services; (7) Inspection; (8) Test Control; (9) Control of Measuring and Test Equipment; (10) Handling, Storage, and Shipping; (11) Corrective Action; (12) Quality Assurance Records; (13) Audits.

Description of Issue:
The LA does not contain sufficient detail on how the "other quality assurance elements" portions of the TRISO-X management measures program will be applied to IROFS in a manner consistent with an item's importance to safety.

Information Needed:
Describe how the "Other Quality Assurance (QA) Elements for IROFS," as described in LA Section 11.8 of the TRISO-X management measures program, are applied to IROFS. Specifically, discuss how the TRISO-X QA program will grade IROFS commensurate with the reduction of risk attributable to that item and how each of the quality assurance elements is applied to IROFS in a manner consistent with their grade.

TRISO-X Response:
The same level of management measures is applied to IROFS for both intermediate and high consequence events. IROFS protecting against intermediate consequence events are not graded to fewer management measures than those for high consequence events. IROFS are graded by type: 1) passive engineered control, 2) active engineered control, 3) enhanced administrative control, and 4) administrative control. Section 4.4 of the ISA Summary details how the graded approach for management measures in LA Section 11.8 is applied to each type of IROFS.

References
None.

License Application Changes
None.

RAI 1-5 – Qualify Special Processes

Regulatory Basis:
In accordance with 10 CFR 70.62(d), each applicant must establish management measures to ensure that IROFS, as documented in the ISA Summary, provide reasonable assurance that they will be designed, implemented, and maintained in such a way as to ensure that they are available and reliable to perform their intended functions, when needed, to comply with the performance requirements of 10 CFR 70.61. The degree to which measures are applied may be a function of the item's importance in meeting the performance requirements.

NUREG-1520, Revision 2, Chapter 11, "Management Measures," gives examples of how some QA elements of a management measures program are not conducive to grading. Special processes are one such QA element. It provides the following guidance regarding special processes:

> "Control of Special Processes:
> Where used, special processes such as welding, heat treating, and nondestructive examination should be performed by qualified personnel using qualified procedures."

Description of Issue:
The LA does not contain sufficient detail on how TRISO-X will adequately implement the Control of Special Processes element of the "Other Quality Assurance (QA) Elements for IROFS" portion of its management measures program.

Information Needed:
Describe how TRISO-X plans to qualify personnel and procedures involved in special processes.

TRISO-X Response:
Special processes identified by Engineering that control or verify quality (for example, welding or nondestructive examination) are performed by qualified personnel using approved procedures in accordance with specified requirements, codes, or standards. When the outcome of the process is highly dependent on personal skills, such individuals are certified in accordance with specified requirements. When the outcome is highly dependent on control of process parameters, the process and equipment are prequalified in accordance with specified requirements. Special process plans and/or procedures prescribe the necessary equipment, process parameters, calibration, and acceptance criteria. Records are maintained of currently qualified personnel, processes, and equipment for special processes.

References
None.

License Application Changes

LA Section 11.8 *Other Quality Assurance (QA) Elements for IROFS,* Item 9, *Control of Special Processes* will be revised to include the following paragraph.

Special processes identified by Engineering that control or verify quality (for example, welding or nondestructive examination) are performed by qualified personnel using approved procedures in accordance with specified requirements, codes, or standards. When the outcome of the process is highly dependent on personal skills, such individuals are certified in accordance with specified requirements. When the outcome is highly dependent on control of process parameters, the process and equipment are prequalified in accordance with specified requirements. Special process plans and/or procedures prescribe the necessary equipment, process parameters, calibration, and acceptance criteria. Records are maintained of currently qualified personnel, processes, and equipment for special processes.

2. HUMAN FACTORS ENGINEERING – PART 1

RAI 2-1 – Human Factors Program

Regulatory Basis:
The 10 CFR 70.61(e) states, in part, that required administrative controls shall be designated as an IROFS and that the safety program of 10 CFR 70.62 shall ensure that each IROFS will be available and reliable to perform its intended function when needed.

The 10 CFR 70.62(d) states, in part, that applicants shall establish management measures to ensure compliance with the performance requirements of 70.61, that the measures applied to a particular administrative control may be graded commensurate with the reduction of the risk attributable to that control, and that management measures shall ensure that administrative IROFS required by 70.61(e) are designed, implemented, and maintained as necessary to ensure they are available and reliable to perform their function when needed.

NUREG-1520, Revision 2, Section 3.4.3.1, “Safety Program and Integrated Safety Analysis Commitments,” and Appendix E, “Human Factors Engineering [HFE] for Personnel Activities,” provide guidance for one acceptable method to determine that HFE has been applied to personnel activities identified as safety significant.

Description of Issue:
Section 11 of the LA states that the ISA Summary identifies IROFS applied to facility systems and activities to assure they function to satisfy the performance requirements of 10 CFR 70.61. Section 5.10 of the ISA Summary describes the consideration of human factors within the context of both administrative controls and enhanced administrative controls. However, neither the LA nor ISA Summary describe an HFE program. This HFE programmatic information is necessary to establish assurance in the reliability of administrative IROFS that are credited under the ISA.

Information Needed:
Please describe how the TRISO-X Human Factors Engineering (HFE) program will address the areas that are associated with personnel activities including:

- Identification of Personnel Activities;
- HFE Design Review Planning;
- Operating Experience Review;
- Functional Allocation Analysis and Task Analysis;
- Human-Systems Interfaces Design, Inventory, and Characterization;
- Staffing;
- Procedure Development;
- Training Program Development; and
- Verification and Validation.

TRISO-X Response:
Consistent with NUREG-1520, Section 3.4.3.1, paragraph 3, human factors engineering (HFE) and practices are implemented through several safety program elements – the ISA Program (LA Chapter 3), the Training and Qualification Program (LA Section 11.3), and through procedure development and implementation (LA Section 11.4) – to ensure that IROFS and management measures perform their functions in meeting the requirements of 10 CFR Part 70. The TRISO-X HFE Plan

included in the Attachment to this Enclosure addresses the review areas referenced above.

References
None.

License Application Changes
None.

3. STRUCTURAL – PART 1

RAI 3-1 – Design-Basis for Local Intense Precipitation

Regulatory Basis:

This information is necessary to demonstrate compliance with the regulations in 10 CFR 70.64(a)(2), which states, in part, that the design must provide for adequate protection against natural phenomena with consideration of the most severe documented historical events for the site. The guidance in NUREG-1520, Revision 2, describes, in part, one acceptable approach to demonstrate compliance with the regulation and includes the acceptance criteria used for the NRC staff's review.

Description of Issue:

Section 1.1.2, "Facility Building and Structures," of the LA describes the design-basis values and their corresponding annual probability of exceedance of each natural phenomena hazard considered in the design of the facility. However, the application does not include the design-basis values for the design of the facility against local intense precipitation and/or local storm runoff. A description of the design-basis values for each design-basis event applicable to the site (e.g., meteorological, seismic, hydrological and geological events) is necessary to demonstrate that the design of the new facility will provide adequate protection against natural phenomena hazards.

Information Needed:

Provide the values used for the design-basis of the facility against local intense precipitation (i.e., 15-minute and 60-minute precipitation design intensities applicable for the site) and their corresponding annual probability of exceedance.

TRISO-X Response:

The design rain load for the TRISO-X Fuel Fabrication Facility is 6.14 in/hr (15-min duration) and 3.24 in/hr (60-min duration). These rainfall intensities have a corresponding annual probability of exceedance of once in 100 years.

References

1. ASCE 7-16, Chapter 8.2, Roof Drainage
2. IBC 2018, Section 1611, Rain Loads
3. NOAA Hydrometeorological Design Studies Center, Precipitation Frequency Data Server, https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=tn

License Application Changes

None.

RAI 3-2 – Evaluation for local intense precipitation

Regulatory Basis:

This information is necessary to demonstrate compliance with the regulations in 10 CFR 70.61 which states, in part, in sections (b) and (c) that the risk of credible high- and intermediate- consequence events must be limited, and section (e) which requires the implementation of items relied on for safety. The guidance in NUREG-1520, Revision 2, describes, in part, one acceptable approach to demonstrate compliance with the regulation and includes the acceptance criteria used for the NRC staff's review.

Description of Issue:

Section 1.1.1.3, "Hydrology," of the LA and Sections 1.4.1, "Flood," and 4.2.5.5, "Design Basis Flood," of the ISA Summary describe and evaluate the effects of flooding due to

nearby water bodies (e.g., river, wetland, creek, etc.). However, the application does not evaluate the effects of flooding due to other flood-related events like local intense precipitation and local storm runoff at the site. As discussed in Appendix D of NUREG-1520, Revision 2, flooding hazards may also be related to local intense precipitation/runoff, storm surge, and other similar events. Therefore, additional information is necessary to demonstrate how the facility was evaluated to prevent or mitigate the consequences of flooding events not related to nearby water bodies, and if additional items relied on for safety need to be identified to demonstrate compliance with the performance requirements in 10 CFR 70.61.

Information Needed:
Provide an evaluation of the effects of flooding due to local intense precipitation and local storm runoff.

TRISO-X Response:
An evaluation supporting this response is still in-process. TRISO-X will submit this response to the NRC by August 18, 2023.

References
None.

License Application Changes
None.

Purpose

Consistent with NUREG-1520, Section 3.4.3.1, paragraph 3, human factors engineering (HFE) and practices are implemented through several safety program elements – the ISA Program (LA Chapter 3), the Training and Qualification Program (LA Section 11.3), and through procedure development and implementation (LA Section 11.4) – to ensure that IROFS and management measures perform their functions in meeting the requirements of 10 CFR Part 70. The purpose of this plan is to present how the HFE areas from NUREG-1520 are considered in the design of IROFS and associated management measures.

Scope

The scope of this plan includes HFE practices applied to personnel activities identified as IROFS. TRISO-X does not have a central control room, rather the manufacturing process is controlled within each local process area. The majority of administrative IROFS are simple one-step controls that involve spacing containers, container weight checks, and piece counts. These administrative IROFS are implemented considering human factors through procedures, training, and workstation postings as operator aids. Human factors engineering is implemented through multiple programs to establish management measures which ensure compliance with the performance requirements of 10 CFR 70.61 as required by 10 CFR 70.62(d).

Background

The TRISO-X ISA Staff has more than twenty years of experience successfully implementing IROFS considering human factors to ensure each IROFS will be available and reliable to perform its intended function in accordance with 10 CFR 70.62. Supplementing this experience, members of the ISA and Training functions attended an industry Human Error Prevention and Mitigation Course in June 2023. This training confirmed the TRISO-X approach for analyzing personnel activities and identifying sources of human errors is consistent with the chemical industry. NUREG-1513 provides guidance recognizing that fuel cycle facilities are, to a large extent, chemical processing plants, therefore the ISA techniques that have been applied to plants in the chemical and petrochemical industries are generally applicable to NRC-regulated facilities. TRISO-X incorporates guidance from the Center for Chemical Process Safety's (CCPS) *Guidelines for Hazards Evaluation Procedures* as referenced in NUREG-1513, to provide effective approaches for addressing human factors. In addition, TRISO-X incorporates guidance from CCPS *Human Factors Methods for Improving Performance in the Process Industries,* which is referenced in the CCPS *Guidelines for Hazards Evaluation Procedures.*

HFE Areas from NUREG-1520, Chapter 3, Appendix E

1. Identification of Personnel Activities

The Training and Qualification Program (LA Section 11.3) establishes and routinely evaluates position requirements for all TRISO-X personnel. Task analyses will be performed to identify personnel activities needed to ensure that each IROFS will be available and reliable to perform its intended function in accordance with 10 CFR 70.62. Standard operating procedures and training objectives will be developed based on the task analysis. Each position involving personnel assigned to SNM process operations will be evaluated to determine the specific requirements that apply to the defined job function (LA Section 11.3.2).

2. HFE Design Review Planning

The Configuration Management (CM) Program (LA Section 11.1) evaluates modifications to systems and components to ensure that configuration changes do not adversely impact currently implemented IROFS and to ensure new processes meet the performance requirements of 10 CFR 70.61. LA Section 11.1.4 clarifies that modifications to existing drawings, procedures, and training (which includes HFE design reviews) are addressed prior to implementing a change as required by 10 CFR 70.72(a).

Applicable human factors checklists are used to support design. The CCPS book, *Guidelines for Hazards Evaluation Procedures*, as referenced in NUREG-1513, provides effective approaches to address human factors. This includes using a Positive and Negative Human Factors checklist provided in Table 9.7. Another recommended method is to use the human factors checklist provided in Appendix G of CCPS *Revalidating Process Hazard Analyses*. The CCPS book, *Human Factors Methods for Improving Performance in the Process Industries*, provides additional guidelines for evaluating human factors. TRISO-X has performed Process Hazards Analyses to review the initial design considering human factors issues using the relevant parts of the human factors checklist provided in Appendix G of CCPS *Revalidating Process Hazard Analyses*. These approaches are also used to implement IROFS commensurate with the complexity of the IROFS to demonstrate compliance with 10 CFR 70.61(e).

The majority of administrative IROFS are simple one-step controls that involve spacing containers, container weight checks, and piece counts. These IROFS are implemented through procedures, training, and workstation postings as operator aids.

The requirements for procedure development and implementation are listed in LA Section 11.4, and the requirements for training and qualification for handling SNM are listed in LA Sections 11.3 and 11.3.2.

3. Operating Experience Review

PHAs are performed for each part of the manufacturing process and include review of events from the Chemical Safety Board and NRC Information Notices that are attributed to hazards relevant to the TRISO-X manufacturing process. PHAs include previous incident reviews which consist of relevant incidents from pilot facility operations (if any). Once operational, PHA updates will include previous incident reviews which consist of relevant incidents from similar or existing processes to help understand process failures that can occur and lead to safety consequences (releases, shutdowns, unscheduled outages, etc.). Human factors engineering and human-systems interfaces are considered in these reviews which include actual incidents as well as near misses.

Training lesson plan development includes the incorporation of lessons learned and operating experience.

4. Functional Allocation Analysis and Task Analysis

Process optimization modelling software is being utilized to estimate operator resource loading. When available, inputs to the process model are based upon operating experience using commercial-sized equipment at a pilot facility. Functional allocation is determined by using operating experience (both industry and internal) to develop procedures and training once the tasks have been defined.

For IROFS involving human actions, task analyses will be used to develop standard operating procedures and training objectives. Human actions in IROFS will be identified in standard operating procedures with markings to ensure IROFS steps stand out from surrounding steps.

5. Human-Systems Interfaces Design, Inventory, and Characterization

HSIs are not currently used for administrative IROFS. Scales and other instruments are designed with appropriate readings, indicators, and gauges considering the guidelines from the CCPS book, *Human Factors Methods for Improving Performance in the Process Industries*.

If HSIs are later added as part of the change process to implement enhanced administrative IROFS, the HSI design process will utilize applicable methods drawn from the guidelines in the CCPS book, *Human Factors Methods for Improving Performance in the Process Industries.*

6. Staffing

Task and staff analyses will be used to determine the number and qualifications of operations personnel for the full range of plant conditions and tasks, including operational tasks (under normal, abnormal, and emergency conditions), plant maintenance, plant surveillance, and testing.

The staffing analysis will be performed for initial staffing goals and modified based on plant changes and as additional information from the HFE analyses from other elements becomes available.

Process optimization modelling software is also being utilized to estimate operator resource loading.

7. Procedure Development

The conduct of operations involving the handling of SNM and/or IROFS in accordance with approved procedures is included in LA Section 11.4 and provides details for the development and implementation of procedures.

- Task analyses will be used to ensure human factors are accounted for in development of standard operating procedures.
- IROFS will be identified in procedures with markings to ensure IROFS steps stand out from surrounding steps.
- Procedures will require a multidiscipline safety review to ensure IROFS are implemented in the applicable procedures.
- Operation walkdowns of procedures will be conducted to ensure procedures can be followed prior to use.
- Periodic review of procedures will be conducted by operations personnel and safety.
- Audits and inspections of the procedures will be performed by safety and quality.

8. Training Program Development

The TRISO-X Training and Qualification Program (LA Section 11.3) uses a systems approach for developing personnel training that includes the following aspects:

- Systematically analyzes tasks and jobs to be undertaken.
- Develops learning objectives derived from analyzing the desired performance after training.

- Designs and establishes training based on the learning objectives.
- Evaluates the trainees' mastery of the objectives during training.
- Assesses and revises the training based on the performance of trained personnel in the job setting.

The TRISO-X Training and Qualification Program also provides the following elements:

- Establishes and routinely evaluates position requirements for all TRISO-X personnel.
- Training is organized into lesson plans or other formal guides to deliver consistent content and evaluation of performance.
- Lesson plans are approved by training management, subject matter experts, and the applicable department management.
- Trainees are evaluated using exams and/or performance-based criteria using the actual tasks whenever possible (if not possible, conditions, tools, etc. will represent actual task to the extent possible).
- The training program is evaluated to refine/revise training as needed using trainee testing and course/instructor evaluations.

The TRISO-X Training and Qualification Program will include the following elements at the appropriate stage of facility development:

- Provide work training to operating personnel and others handling greater than lab sample quantities of SNM.
- Provide 3-year refresher work training for operating personnel.
- Develop training objectives and standard operating procedures based on task analyses.
- Include lessons learned and OE in lesson plan development.
- Include applicable IROFS information/documents in lesson plans.
- Evaluate the training program to refine/revise training as needed using the following:
    - Work-in-Progress evaluations of qualified personnel
    - TRISO-X audits by Quality Assurance personnel
- Provide formal safety training commensurate with position to all TRISO-X personnel for the following topics:
    - Chemical Safety
    - ISA
    - Radiation Protection
    - Nuclear Criticality Safety
    - Environmental Safety
    - Security
    - Fire Prevention
    - Emergency Response
- Provide periodic refresher training (as required) on safety trainings.

9. Verification and Validation

The technical accuracy of operating procedures is verified during development (LA Section 11.4.1). New operating procedures are validated by operations staff to ensure that they can be performed as written. Changes to existing operating procedures are evaluated to determine if the scope of the change warrants a walk-down and/or an independent verification/validation.

Procedures governing activities relied on for safety involving the handling of SNM and/or IROFS are reviewed periodically to ensure content remains current and relevant and that administrative IROFS remain available and reliable (LA Section 11.4.5).

Audits and inspections of procedures are performed by safety and quality (LA Section 11.5).

References

1. Center for Chemical Process Safety, Guidelines for Hazards Evaluation Procedures, 3rd Ed., 2008
2. NUREG-1513, Integrated Safety Analysis Guidance Document, 2001
3. Center for Chemical Process Safety, Revalidating Process Hazard Analyses, 2001
4. Center for Chemical Process Safety, Human Factors Methods for Improving Performance in the Process Industries, 2007
5. NUREG-0711, Rev. 3, Human Factors Engineering Program Review Model, 2012