INL/EXT-19-56309
Revision 0

NSUF University Research Reactor Fitness Study Report

December 2019

Heidrich, B. – Idaho National Laboratory

Geuther, J. – Penn State University
Lund, M. – University of Utah
Meffert, B. – University of Missouri at Columbia
Townsend, C. – Purdue University.

Changing the World's Energy Future

Idaho National Laboratory

INL is a U.S. Department of Energy National Laboratory operated by Battelle Energy Alliance, LLC

INL/EXT-19-56309
Revision 0

NSUF University Research Reactor Fitness Study Report

Heidrich, B. – Idaho National Laboratory

Geuther, J. – Penn State University
Lund, M. – University of Utah
Meffert, B. – University of Missouri at Columbia
Townsend, C. – Purdue University.

December 2019

Idaho National Laboratory
Nuclear Science User Facilities
Idaho Falls, Idaho 83415

http://www.inl.gov

Prepared for the
U.S. Department of Energy
Office of Nuclear Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

Page intentionally left blank

SUMMARY

The Nuclear Science User Facilities has been working with the National Organization of Test, Research, and Training Reactors to collect input from the US university reactor community on their current and future needs. The effort started with a web survey to collect initial data. NSUF held a follow-up workshop at the Center for Advanced Energy Studies in Idaho Falls. Four areas of interest were identified by the university research reactor community that can affect future operations and sustainability of the reactors: capital infrastructure, regulatory burden, staffing and knowledge transfer, and utilization and relevancy. Members of the community presented challenges and best practices from their facilities. Discussions were held to create and distill the list of challenges for each area. A working group was formed for each area to continue the discussion and prioritize the challenges. NSUF and the working groups created this recommendations report to document the progress of this study. TRTR will provide additional input from the university research reactor community for input into the NSUF Nuclear Energy Gap Analysis Report for FY2020, which may be used to inform the FY2021 Scientific Infrastructure FOA.

The following items were identified during the study as being high priority issues for the US university research reactor community:

Infrastructure:

- Identification of replacement schedule and costs across all the reactors.
- Applicant labor costs for upgrades and basic infrastructure upgrades are not covered by FOA award.

Regulation and Licensing:

- Lack of effective process for clarifying regulatory interpretations.
- Uncertainty and perception of regulatory risk in making facility changes.

Staffing and Knowledge Transfer

- Sharing best practices on documentation and knowledge transfer between facilities.
- Increasing knowledge sharing between national laboratories and universities.

Utilization and Relevancy

- Developing funding to support utilization infrastructure and staff.
- Communicating the capabilities and impact to universities and funding agencies.

These items are discussed in detail in the body of the report, along with proposed solutions.

Page intentionally left blank

CONTENTS

Figure

Table

Page intentionally left blank

ACRONYMS

ARM	area radiation monitoring
ATR	Advanced Test Reactor
CAM	continuous air monitor
CSIS FOA	Consolidated Scientific Infrastructure Support Funding Opportunity Announcement
DOE-NE	Department of Energy -- Office of Nuclear Energy
FSAR	Final Safety Analysis Report
FTE	full-time equivalent
HFIR	High Flux Isotope Reactor
IAEA	International Atomic Energy Agency
I&C	instrumentation and controls
INL	Idaho National Laboratory
LAR	license amendment request
MTR	Materials Test Reactor
NEI	Nuclear Energy Institute
NEUP	Nuclear Energy University Programs
NIST	National Institute of Standards and Technology
NI	nuclear instrumentation
NPP	nuclear power plant
NPUF	non-power utilization facilities
NSUF	Nuclear Science User Facilities
OGC	Office of General Counsel
RAI	request for additional information
RRI	Research Reactor Infrastructure
RTR	research and test reactor
SER	safety evaluation report
SME	subject matter expert
TRIGA	Test, Research, Isotopes, General Atomics
TRTR	National Organization of Test, Research, and Training Reactors
URR	university research reactor
US NRC	US Nuclear Regulatory Commission

Page intentionally left blank

NSUF University Research Reactor Fitness Study Report

1. BACKGROUND

1.1 Purpose of this Report and the Study

The nation's fleet of Test, Research, and Training Reactors (TRTRs) serves as a vital resource for educating the next generation of nuclear engineers and as a flexible testbed for innovative reactor technologies. The reactors typically have a very small staff with responsibilities ranging through research and operations, isotope production, regulatory compliance, facility maintenance, and university teaching obligations. This large set of requirements leaves little time for performing future outlook and preparing for major upcoming work. As the fleet continues to age, many facilities will require major renovations with significant capital costs. At its peak, the United States was home to over 80 facilities; however, today there remains only 24 colleges and universities who offer access and training at a fully operational nuclear reactor. The proposed work will conduct a comprehensive survey of all TRTR facilities to provide a complete posture review of the fleet.

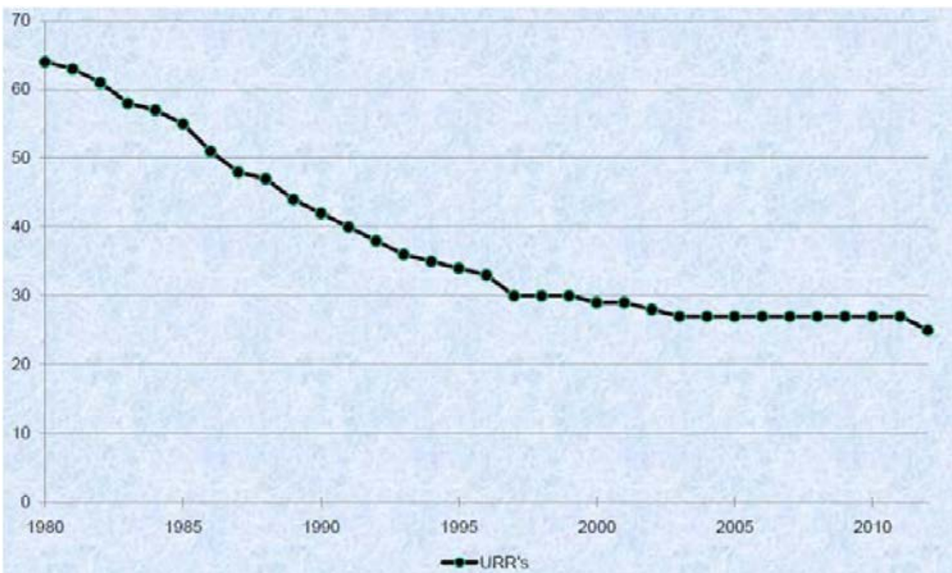


Figure 1. Operating US University Research Reactors. [1]

1.2 Background of this Study

The Nuclear Science User Facilities (NSUF) has been working with the National Organization of Test, Research, and Training Reactors to collect input from the US university reactor community (see graph in Figure 1 above) on their current and future needs. Initial discussions with TRTR began at the 2017 annual meeting of TRTR, held in San Diego, CA. This study began with a web survey in March 2019 to collect initial data and identify areas of concern. NSUF held a follow-up workshop in July 2019 at the Center for Advanced Energy Studies in Idaho Falls. We identified four areas of interest in the university research reactor community that can affect future operations and sustainability of the reactors: capital infrastructure, regulatory burden, staffing and knowledge transfer, and utilization and relevancy. Members of the community presented challenges and best practices from their facilities. Discussions were held to create and distill the list of challenges for each area. A working group was formed for each area to continue the discussion and prioritize the challenges. Preliminary results were presented at the 2019

Annual meeting of TRTR, held in Idaho Falls, ID. Feedback was received from the community during that meeting. NSUF and the working groups have created this recommendations report to document the progress of this study. TRTR will provide additional input from the university research reactor community for input into the NSUF Nuclear Energy Gap Analysis Report for FY2020.

1.3 Background of University Reactor Support from DOE/AEC

The Department of Energy–Office of Nuclear Energy and also the Atomic Energy Commission have supported US university research reactors since the beginning, seeing them as vital tools for teaching, education, and service work for the advancement of peaceful uses of nuclear technology.
DOE-NE supplies fuel to these reactors as well as funding for infrastructure to support and improve the safety, performance, control, or operational reliability of the research reactor, including security/safety enhancements required by the federal/state/local regulatory agencies and for equipment and instrumentation that significantly improve or expand the research, instruction, training capabilities, or operating capabilities related to NE program missions (e.g., utilization or handling of radiological or radioactive materials) of the research reactor facility, including radiation detection and measurement equipment.

The current vehicle for this support is the Scientific Infrastructure Support for Consolidated Innovative Nuclear Research Funding Opportunity Announcement (DE-FOA-0002129) for FY2020. The average annual budget for the reactor upgrades area ranges between 2.5-3MM$. Since 2009, this program has funded 82 projects at all 24 universities, allocating a total of $27,106,146. [2]. The largest projects are typically reactor control console and safety system upgrades or replacements. Control consoles monitor reactor power, fuel temperature, and radiation levels and provide both control of the reactor and safety shutdown functions. They are vital to the safety and utilization of the reactor facilities. Console projects are usually 2-3 years and 1-1.5MM$. They tend to be complex projects requiring significant planning, execution support, and licensing efforts.

The Research Reactor Infrastructure (RRI) program supplies fuel to the university reactors through a parallel program. Funding for both programs flows through the DOE-NE University Program (NEUP). The Nuclear Science User Facilities (NSUF) administers the Scientific Infrastructure FOA for DOE-NE and Idaho National Laboratory administers the RRI fuels program.

While the infrastructure and fuels programs have been vital for the survival and continued excellence of the US university research reactor community, it is expected that recommendations resulting from this study may fall outside these traditional means of support.

2. PROCESS OF THIS STUDY

NSUF leads this study, with support from INL Systems Engineering and the TRTR universities. This work was supported by the U.S. Department of Energy, Office of Nuclear Energy under DOE Idaho Operations Office Contract DE-AC07- 051D14517 as part of the NSUF infrastructure management activities.

2.1 Survey – April-May 2019

A Qualtrics web survey was performed from April to May 2019 to gather information on challenges and opportunities associated with university research reactors. Contact information was gathered for all 25 of the university research reactors (URR), and a survey invitation email was distributed in March 2019. Several follow-up emails and direct phone calls were required, but 23/24 universities responded to the initial survey (96%). Some universities made multiple responses after gathering additional information.

Survey questions were generated by NSUF and the TRTR collaborators. They are focused in three areas:

1. Infrastructure
    a. Have you completed a full replacement of your control console in the last 10 years?
    b. Are you planning on completing a full replacement in the next 10 years?
    c. Are you planning a digital Instrumentation and Controls (I&C) upgrade?
    d. Are there upgrades at your reactor needed to support future maintenance, i.e., vacuum tubes, electronics, or software not currently supported that should be replaced?
    e. Do you have any safety significant equipment for which you do not have spares?
    f. Do you have any current single point failures?
    g. Are there any upcoming big-ticket items at your reactor, other than consoles, that should be reviewed/discussed?
    h. Are there any safety (CAMS, detectors, etc.) or increased utilization upgrades (such as increased cooling/power level/Ar-41 mitigation) that could immediately benefit the reactor?
    i. Are there any systems or components at your facility with chronic recurring issues?
2. Regulation and Licensing
    a. How do you perceive that the regulatory environment has changed over the last 10 years?
    b. How do you perceive that the regulatory burden has changed over the last 10 years (i.e., time spent on licensing, inspections, and compliance activities)?
    c. Are there any significant regulatory challenges associated with instrumentation and control system upgrades that are beyond the capability of your facility?
    d. Current rulemaking underway by the licensing branch of the U.S. NRC will reclassify research and test reactors into the Non-Power Utilization Facility status and begin to implement indefinite licensing periods for the facilities. How will you deal with this?
    e. Once the first revised Safety Analysis Report (SAR) is submitted, would a lessons-learned benefit the TRTR community?
    f. When was your SAR last reviewed?
    g. When was your last significant licensing action (License Amendment Request [LAR] or relicensing) or major facility change? (please explain)
    h. What process do you use to fill out and evaluate 10 CFR 50.59 facility changes?
3. Staffing and Knowledge Transfer
    a. What changes do you see in the coming 3, 5, 10 years for your facility staff?
    b. Does your facility have a succession plan?
    c. Do you have the resources to perform a major licensing action coincident with a major facility update?
    d. Provide an estimate of the various time allocations facility staff must put toward education, operations, regulatory compliance, and maintenance.
    e. State the number of staff, % of full-time staff, % of teaching faculty, and number of student operators.

f. Please breakdown your staff members and experience (e.g., Reactor Director = 22 years, SRO1 = 5 years, electronics technician = 2 years, etc.).
g. What sort of help could your facility use with respect to staffing and/or knowledge transfer?
h. Are you active in the TRTR community? (attendance at TRTR events, etc.)
i. Are you aware of the DOE-NE Research Reactor Upgrades funding program?
j. Do you plan to receive or ship fuel in the near future?
k. Do you have the staff/resources to perform this activity?

The specific results from the survey are maintained by NSUF but are not replicated in this report. Some facilities requested anonymity due to the sensitive nature of the questions. Each area is broken into additional detail below, along with over-arching issues arising from the survey results. General survey responses and limited data analysis are provided in Appendix A.

2.1.1 Infrastructure

Main areas of inquiry in Survey	Overarching Issues from Survey Data
Control Consoles	equipment aging
Major Infrastructure	equipment obsolescence
Safety Equipment	manufacturer goes out of business
Maintenance	civil engineering (building) issues
	digital console conversion
	critical spare parts

2.1.2 Regulation and Licensing

Main areas of inquiry in Survey	Overarching Issues from Survey Data
Changes in Regulation	Burden is a drain on facility resources
Facility Change Control	Reluctance to upgrade equipment
Licensing and FSAR	NRC use of nuclear power plant (NPP) contractors for licensing reviews
	Lack of internal SME for analysis to support LAR/SAR work (contractor vs. training)
	Utility of 10CFR50.59 process for changes
	Disproportionate impact on smaller facilities

2.1.3 Staffing and Knowledge Transfer

Main areas of inquiry in Survey	Overarching Issues from Survey Data
Staffing Changes Staffing Requirements Knowledge Transfer Fuel Shipments	recruiting and keeping permanent staff utilization of students (as operators and other roles) succession and knowledge retention planning SME staff vs. flexibility access to external SME resources standardized safety analyses, etc. ease of fuel shipment/receipt

2.2 Workshop – July 2019

The survey results were used by NSUF to organize the workshop to bring the university reactor community together and refine the issues discovered in the survey. A fourth area, Utilization and Relevancy, was added for the workshop, arising out of the survey results. The overarching issues here were:

1. Educational Utilization (courses and laboratories)
2. Research Utilization (graduate and faculty)
3. Commercial Service Work (isotope production, neutron activation analysis, radiography)
4. Diversity of Customers
5. Novel Applications of research reactors
6. Licensing/Regulatory Barriers to Performing Work (1-3).

Eighteen university reactor faculty and staff, representing 15 facilities, attended the NSUF workshop. The agenda, presentations, and discussions are attached as Appendix B to this report. ThinkTank collaboration software was used to facilitate discussion and capture the results. Facilitation of the workshop and expertise in ThinkTank was provided by the INL Systems Engineering Department. In addition to university representation, both DOE-NE and DOE-ID participated in the workshop. The INL Senior Leadership Team was represented by Dr. Sean O'Kelly, the Associate Laboratory Director for the Advanced Test Reactor and the 2019 Chair of the TRTR organization.

The workshop was organized around the four major areas, with a review of the survey results, followed by two presentations from universities on specific challenges in that area and two presentations on best-practices or opportunities in that area. The topic area was closed out with a facilitated discussion (in ThinkTank) of the area, with the goal of identifying a list of challenges. A volunteer from the university was selected to serve as the working group chair for each area and co-authors for this report.

The second day of the workshop was reserved for working group break-out sessions with the goal of refining the list of challenges, prioritizing the list, and proposing draft solutions. This effort was later expanded for the TRTR panel session, and finally this report. The four working group chairs are shown in Table 1.

Table 1. University Working Group Chairs.

Focus Area	Working Group Chair	University
Infrastructure	Matthew Lund	University of Utah
Regulation and Licensing	Bruce Meffert	University of Missouri, Columbia
Staffing and Knowledge Transfer	Dr. Jeff Geuther	Pennsylvania State University
Utilization and Relevancy	Clive Townsend	Purdue University

The working group chairs led the four breakout sessions at the July workshop to further develop their topic areas into two main challenges and two proposed solutions. The results of that work are shown here. Additional discussion during the workshop can be found in Appendix B. Sections 2.2.1 – 2.2.4 are the product of the university reactor working groups and are not NSUF recommendations to DOE-NE. Additional work will be performed in FY2020 and any NSUF recommendations will be contained in the FY2020 Nuclear Energy Scientific Infrastructure Gap Analysis Report (June 2020).

2.2.1 Infrastructure Working Group Results

Problem Statement

The infrastructure of research reactors is over 20 to 60 years old with aged and obsolete components and equipment. The industry has a very limited number of suppliers and finite knowledge about research reactor components, system, and integration. Without substantial investment and continued upgrades, research reactors will no longer be able to operate and meet the required demand for research, radioisotope production, and education.

Identified Challenges (Discussion Items)

The reactor fitness workshop identified the following key issues with the current reactor infrastructure including:

- Equipment Aging/Obsolescence – Reactors were constructed in the 1950s-1970s with partial retrofits of existing systems over the years. Existing control consoles use parts that are no longer available with mostly custom designed components. Reactor systems such as radiation monitors, cooling systems, controls, etc. are nearing or past their expected lifetime, needing replacement.
- Civil Engineering (building issues) – Most of the reactor buildings are old with outdated noisy power systems, old cooling and exhaust systems that fail, and aging infrastructure, all of which cause regular downtime.
- Digital Console Conversion – Newer console designs use digital components, requiring License Amendments through the NRC.
- Critical Spare Parts – Critical components and replacement parts are no longer available, such as control rod drives, instrumented fuel, neutron detectors, neutron monitoring channels, and electrical components. This prevents the simple swapping of like parts with like parts, forcing facilities to spend time finding similar components that meet 10CFR50.59 guidelines.
- Equipment lifetime for components is becoming shorter than the time required to get those components, such as for control rod drives or neutron monitoring channels that take many years to be designed, purchased, constructed, and approved, by which time the components needed to build are no longer available.
- DOE grants now only have one no cost extension, which is a problem with projects with long lead times such as consoles and neutron channels. Several facilities have experienced multiple

year delays with manufacturer issues and staffing changes, making it difficult to complete projects within the anticipated timeline.

- No "Off-the-Shelf" Parts – Off-the-shelf parts are not available for research reactors; almost every component is custom designed. Thus, if a part fails, a brand new component must be custom designed requiring multiple years for replacement instead of a quick swap. This causes research reactor to be down for extended periods of time.
- Disappearing Vendors – The original manufacturer for reactors and components no longer build reactors or components or are out of business. This has reduced the number of available companies with less competition, resulting in increased cost for components and longer lead-out times. The knowledge of these manufacturers is being lost, along with the design drawings, component knowledge, and technical support.
- Licensing Uncertainty – Facilities experience issues with license uncertainty when upgrading major components, whether or not those will fall under 10CFR50.59 or requiring a license amendment. If a license amendment is required, facilities will be shut down for an extended period of time waiting for a license amendment that may fail to pass or take 2-3 years to be approved.
- Lack of Expertise – Facilities lack expertise in electronics repair, system repair, and licensing to update or repair existing systems. Facilities with only two or three staff members do not have full time dedicated staff for repairing reactor systems.
- Not Using Lessons Learned from Other Facilities – As facilities start the upgrade process, they may not be using other facilities to learn from instead of making those same mistakes. For example, INPO for commercial powerplants creates technical bulletins shared among powerplants with information about best practices and lessons learned. The TRTR community shares some lessons learned, but there is no central database of existing parts, components, and lessons learned for research reactors.

Highest Priority Challenges
The following are the two highest priority needs for research reactor infrastructure:

<u>Challenge #1: Identification of replacement schedule and costs across all the reactors.</u>

Without a detailed systematic mechanism to evaluate plant lifetimes, failure rates, replacement costs, and timeline, it is difficult for facilities to make cost estimates of how much long term funding they will need to keep a reactor in good condition and working. A comprehensive database of needs for all facilities will help the DOE provide funding long term to meet reactor needs.

<u>Proposed Solution</u>

1. Identify replacement schedule and costs across all the reactors.
    a. The community will use a standardized format of determining replacement schedules with costs. The database will be maintained by the TRTR community with DOE anonymized database of the results to use for requesting funding.
    b. Method for evaluation should follow industry standards, for example, the method used by ATR with a template provided by DOE.
    Provide a DOE sponsored audit program with a group of external auditors (DOE or TRTR members), visiting each facility to help complete initial survey.
    c. Submit a final report to DOE asking to fully fund costs discovered in survey.
2. Identify previous upgrade costs and make available to community.
    a. Utilize upgrade project designs and costs completed at other facilities as basis for design and budget basis.
    b. Create a more detailed overview of prior year awards, dollar amounts, and final report from the infrastructure grant that details vendors.

c. Create database of vendors, components used in research reactors, lessons learned, challenges, design strategy, etc. available to research reactors.

Challenge #2: Applicant labor costs for upgrades and basic infrastructure upgrades are not covered by FOA award.

Organizations are responsible for a large part of the upgrades, which they may not have the financial ability or human manpower to provide, preventing them from completing needed updates.

Proposed Solution

1. Make available smaller grant opportunities to cover design study and preparation for larger projects.
2. Update the FOA to reflect current University Research Reactor needs by:
    a. Including basic civil infrastructure upgrades, such as power or ventilation.
    b. Include applicant labor costs for upgrades into proposals.

Path Forward

1. Secure DOE funding and support to create a database of replacement schedules.
2. Create a database of costs using a standardized format.
3. Submit a report to DOE outlining long term funding needs per year with request to support building infrastructure and internal labor costs.
4. Create accessible database of vendors, components, and lessons learned regarding research reactors.

2.2.2 Regulation and Licensing Working Group Results

On July 17, 2019, during the Reactor Fitness workshop, a working group consisting of about six persons representing six separate research reactor facilities gathered to brainstorm the existing challenges research reactors face in facility licensing and regulation. Then, this small working group presented the entire list of challenges to all workshop participants. A facilitated discussion boiled the list down to five (5) challenge statements. Anonymous computer voting reduces the list down to the two (2) most important licensing and regulation challenges for the entire research reactor community.

The agreed upon two challenge statements generated from this working group are:

Challenge #1: Lack of effective process for clarifying regulatory interpretations

The research reactor community has a few long-standing standards and regulations which are open for interpretation. The licenses and the regulator all need to have the same, consistent interpretations for these on-going topics. Otherwise, the licensees are at risk of not conforming to a standard or regulation if interpreted differently by the regulator. Though these interpretation topics have been brought up at American National Standards Institute/American Nuclear Society (ANSI/ANS) 15 standards' meetings and at annual Training, Research, and Test Reactor (TRTR) meetings, the licenses and the regulatory have not come to common interpretations.

Proposed Solution - Lack of Effective Process for Clarifying Regulatory Interpretations

- Share past Nuclear Regulatory Commission (NRC) decisions on interpretation to establish precedent.
- Increase interaction between the NRC and TRTR community. The ANS/ANSI standards committees can only do so much.

- Have the TRTR community submit written interpretation requests to the NRC and have them docketed.
- TRTR effort to send a letter to the NRC with examples of how we have been impacted by the regulator's subjective interpretation of regulations and the delay on clarification.
- Have a dedicated "program manager" NRC staff member track, review, and report on these issues.
- Mandate a turnaround time for questions on regulation interpretations.
- Suggest DOE-NEUP support generic analyses for MTR and TRIGA-type reactors. These analyses can provide high-level guidelines and consistency for setting facility safety limits.
- TRTR should create a consistent message on interpretation and then tell NRC our interpretation on a docketed document. TRTR licensees should take the lead.

Challenge #2: Uncertainty and perception of regulatory risk in making facility changes.

In addition to the risks of interpretation of standards and regulation, the license has both a perceived and actual regulatory risk when making a change to a facility. Significant engineering and licensing evaluation must take place prior to making a change. This evaluation and documentation require a significant investment by the licensee, especially for small facilities with less than five (5) full-time staff. Also, different NRC inspectors have come to different conclusions than both the licensee and other NRC inspectors on decisions such as whether a facility change requires a license amendment or can be performed under the 10 CFR 50.59 process, and there are differences in opinion of the required robustness of 10 CFR 50.59 process. Fear of regulatory risk and/or the regulatory burden of the required documentation is a reason why some facilities have not made improvement changes to their aged facilities. The consequences of not managing aged facility issues could be a future safety or reliability issue for these facilities.

As the two-day workshop was ending, participants proposed solutions to the above two (2) challenges. The following lists are raw, unrefined lists of solutions for each of the two challenges. One of the near-term tasks for the working group will be to consolidate the lists into focused, well-defined solutions.

Proposed Solution - Uncertainty and Perception of Risk in Making Facility Changes

- Suggest DOE-NEUP support generic analyses for MTR and TRIGA-type reactors. These analyses can provide high-level guidelines and consistency for change evaluations.
- Suggest DOE-NEUP support specific analyses for research reactors on a case-by-case basis. These analyses may or may not be in support of DOE-NEUP grant purchased equipment. However, it is highly suggested that DOE-NEUP support the safety evaluation required to implement DOE-NEUP purchased equipment. Lack of staff to properly conduct safety evaluations has been a reason DOE-NEUP purchased equipment has not been installed in a timely manner or small facilities have not applied for NEUP funding.
- Consolidate all 50.59 screenings TRTR wide to understand collective screening threshold.
- Have the TRTR community share successful license amendment requests (LARs) with dockets numbers for others to use a basis for their LARs.
- Have standardized examples of 50.59 evaluations for various systems that all TRTRs have such as rod control, protection systems, indications, etc.
- Create a 50.59 guideline document with TRTR examples similar to the Nuclear Energy Institutes document NEI 96-7. Once the document is finalized, have the NRC endorse the document with a

new NUREG just as the NRC has done with NEI 96-7. A different working group met for the first time in October 2019. A draft 50.59 document specific to the TRTR community is in progress.

- Request NRC create and externally publish a checklist for the LAR process with an expected timeline. The following LAR steps should be addressed in the checklist:
  - Phase 0 Meeting
  - Application Submitted
  - Application Acceptance Review
  - Initiation of Application Review
  - RAI's sent
  - SER sent to the OGC
  - Environmental Impact
  - Approval

During the annual TRTR meeting in September 2019, this information was provided to the attending licensees of the community and the regulators present. All seemed to be supportive of this working groups' efforts and with the working group proceeding towards solutions in these areas. The working group leaders have committed to meeting several times per year to work on solutions.

2.2.3 Staffing and Knowledge Transfer Working Group Results

The findings presented in this section were based on the meeting of the Staffing and Knowledge Transfer Working Group at the University Research Reactor Fitness Workshop held in Idaho Falls in July 2019. These ideas were formed by the entire committee and are presented in an interpreted form, but they do not represent the exact opinion of any one individual. The ideas were compiled in a brain-storming session and then were discussed and voted upon by members of the RTR community in order to prioritize the list. The priorities identified at the workshop ("Proposed Solutions" below) would require some federal assistance in the form of expertise or funding, but would have a significant impact in the quality of research reactor programs at universities by assisting small programs in learning from and emulating larger, more well-established programs. The university RTR community as a whole is accustomed to cooperation toward the common goal of improving nuclear education, safety, and research, as reflected in the solutions proposed herein.

In general, the community has proposed ideas that require small amounts of assistance as a means of enabling the mobilization of willing support from peer reactor programs or as a means of leveraging expertise at DOE laboratories.

Identifying Challenges

Challenges regarding staffing and knowledge transfer were largely related to the varying size of RTR staff. The largest university reactor facility has nearly 200 employees, while several institutions are staffed by a single salaried staff member with support from student operators. Every facility, regardless of its level of staffing, needs to satisfy its license and operate without undue risk to the public. Certain documentation and maintenance requirements will thus exist at each facility, including the performance of emergency preparedness exercises, license-required surveillances, the performance of requalification training, etc.

Small facilities with restricted funding have to meet this obligation but are often at risk of having a single staff member retire and take priceless experience and tribal knowledge with them. Smaller facilities also face challenges when trying to support major licensing actions, such as requests for additional information (RAI) responses, performing SAR revisions and analysis, and writing license amendment requests. Furthermore, smaller facilities may be challenged to produce high-quality, well-written procedures.

The community identified many challenges related to staffing and knowledge transfer during the Research Reactor Fitness Workshop, including:

1. Staff retention;
2. The effective utilization of student operators;
3. Maintaining support for tours without the availability of funding (such as the Reactor Sharing program);
4. Maintaining and organizing important drawings and documents, such as SAR basis documents;
5. Increasing knowledge sharing between national laboratories and universities, e.g., funding the use of outside expertise, in particular when performing analysis for the SAR;
6. Maintaining adequate staffing for major license actions such as LARs and SAR revisions;
7. Sharing best practices on documentation and knowledge transfer between RTR facilities.

Highest Priority Challenges

The two challenges that were voted to have the highest priority were: sharing best practices on documentation and knowledge transfer between RTR facilities; and increasing knowledge sharing between national labs and universities.

Challenge 1 - Sharing best practices on documentation and knowledge transfer between facilities

The varied staff size and resource availability between university RTRs creates an opportunity for large facilities to share expertise and best practices with smaller facilities. The challenge lies in identifying what information would be beneficial if shared between facilities. The federal regulations governing the safe operation of RTRs are universal. However, each RTR has a unique set of procedures and other documents which guide its operations, and it can be surprising to see what different methods are used successfully at other reactors. Peer audits are a very useful tool in this regard, by providing an opportunity for a representative to travel from one reactor facility to another to review processes and provide input based on their own experience at another institution. This process can be accelerated and promulgated by the availability of funding to support travel expenses from sending staff to support audits and technical work at other institutions.

Proposed Solutions

The solutions proposed by university RTR community members for the challenge of sharing best practices and improving knowledge transfer between facilities were the following:

- Establish funding (ideally provided by DOE) to pay for travel expenses incurred during inter-university peer reviews. The cost of a peer review would be the travel and lodging expenses of a single individual over a one to five-day audit. Therefore, it is reasonable to expect a cost of ~$1000 - $2500 per review.
- Establish funding to enable “tiger teams” of experts from RTR institutions to provide technical assistance at a facility with a need for support. For example, a small facility without an electronics engineer or technician could request support from a larger facility with personnel experienced in repairing reactor electronics. The cost of this program would be slightly higher per event than that of a peer review due to the possibility of several institutions simultaneously contributing help but would be far less expensive and time consuming than procuring new equipment. With a dwindling number of control console equipment vendors and the prevalence of license-required electronic equipment

with long lead times and high costs, these “tiger teams” have the potential to allow small facilities to efficiently and inexpensively maintain operability.

- Form a TRTR-sanctioned committee to develop a best practice document for conducting inter-university peer reviews. This is a “zero cost” solution that would ensure that peer reviews are of high quality and adequately cover the required scope.
- Form a funded TRTR working group with a focus on documentation and preserving best practices.
- Add a section to the TRTR newsletter to share best practices (e.g., a “Manager’s Corner” section).
- Encourage RTRs to develop methods of approving personnel from other facilities as trustworthy and reliable in order to facilitate sharing of information.

Path Forward

The proposed path forward to improve sharing of best practices and knowledge transfer between facilities is to request DOE funding for peer reviews to be conducted by members of the university RTR community at peer institutions. These reviews would be based on a set of best practices endorsed by TRTR, Inc. and developed by a TRTR committee. A similar program would provide travel funding for technical experts to travel between RTRs to share expertise and provide technical assistance.

<u>Challenge 2 - Increasing knowledge sharing between national laboratories and universities</u>

It is apparent that many university RTRs lack the budget to maintain a large technical staff. Certain technical expertise is crucial when performing SAR analysis or for a license amendment request, but is only of temporary necessity. A small RTR would struggle to justify, for example, hiring a full-time expert in thermal hydraulics, but may need assistance in designing and interpreting a RELAP5-3D model of their core when applying for an increase in their license power limit. This expertise exists at national laboratories, but channels to allow RTRs access the national lab experts and request assistance need to be established.

Proposed Solutions

A variety of potential solutions to this challenge were proposed by the community. These include:

- Creating a point of contact list containing contacts at national laboratories who can support efforts at research and test reactors;
- Providing DOE-created generic safety analysis for common reactor types to be documented in peer-reviewed publications. This would alleviate the burden and opportunity for error of having every facility perform a unique safety analysis for their facilities, especially when several designs (i.e., TRIGA and MTR) share common characteristics across the RTR fleet.
- Establishing a small budget at DOE to support university reactors, through technical outreach and the use of expertise at national labs;
- Establishing a DOE proposal program to request technical support. This program would be competitive, available year-round, and would be used to provide technical expertise that may not exist at small facilities.

Path forward

The proposed path forward for the challenge of increasing knowledge sharing between national labs and university RTRs is to establish a DOE proposal program to allow university RTRs to request technical assistance from lab experts. This assistance may be used to check or develop reactor physics or thermal hydraulics models or to do other technical work that is outside the scope of day-to-day reactor operations and, therefore, may be outside the expertise of university reactor staff. Furthermore, the laboratory expertise can be leveraged in a more general way by developing peer-reviewed and published safety analysis for common RTR designs such as TRIGAs and MTRs. Access to laboratory experts would increase the quality of safety basis calculations and would alleviate the significant burden of having to hire consultants or permanent staff with specific expertise that is only required during licensing.

2.2.4 Utilization and Relevancy Working Group Results

The fourth working group of the URR Posture Workshop was focused on the Utilization & Relevancy of facilities. The working group noted the extremely broad nature of the capabilities that are available at universities, usually due to the variance in power of the respective reactor. This power can range from watts to megawatts and the mission statements are just as broad. As with other working group areas, challenges were identified, down selected, and solutions proposed.

Identifying Challenges

The challenges identified by the participating facilities had a common theme of communication issues. For many, the faculty at the university lack connection with the capabilities of the reactor. Because the faculty, who are responsible for carrying out the educational mission of the university, do not understand the facility, they cannot implement its offerings in laboratory or other course work. By their very nature, any operational university research reactor will be able to demonstrate some fundamental nuclear engineering principles such as approach to criticality and rod worth measurement. However, if faculty are unaware of the reactor’s status, it will remain underutilized.

Some reactor personnel also noted challenges when returning to a fully operational status following an extended shutdown. Because the customer base must move elsewhere after the facility is inoperable for an indefinite time period, regionally competing facilities will take up the workload. Invested time in learning how a new facility works and getting requisite approvals creates a loyal customer base which is not eager to return to their original neutron supplier. Restoring reactors following major infrastructure upgrades remains a challenge.

Facilities with lower power level noted their struggle in communicating commercial capabilities to suppliers. While the heavy lifts are done by the larger governmental sites (such as NIST, ATR, and HFIR), the wait time for experimental slots can be prohibitive. However, customers remain difficult to identify due to a lack of communication between the rejected scientists and the operational staffs at smaller facilities.

Finally, challenges were expressed regarding the licensing and regulatory barriers to potential work. Customers, both faculty and external to the university, had approached the staff, but schedules were unable to be formed due to the (real or perceived) risk and uncertainty in licensing timeline. The effect on regulatory work was especially pronounced for those facilities with staffs between one and ten FTEs. The regulatory barrier is also realized in infrastructure grants. Multiple attendees voiced their hesitancy to apply for Department of Energy money due to their inability to execute the modification licensure after purchase. Researchers and commercial customers created unrealistic timelines to make modifications which appear trivial to an outsider and daunting to a seasoned veteran. From these challenges, the highest priority issues were identified.

Challenge #1: Develop funding to support utilization infrastructure and staff

Proposed Solution:

To address these issues, the working group would encourage an additional separate funding category specifically geared toward expanding utilization at facilities. Utilization of the reactor and recognizing the role of these critical assets could be a multiagency effort. For example, the Department of Energy and Defense can find value through fundamental research while for the Department of State the intelligence services can increase utilization by recognizing the human capital which has a specialization in novel reactor designs and operations. Additional funding in the form of a percentage of an FTE or graduate student fellowship would significantly alleviate burden on facility staff.

Challenge #2: Communicate capabilities and impact to universities and funding agencies

Proposed Solution:

Communication was the second main obstacle identified. To resolve some of the noted categories of misunderstanding and relevancy deficiency, the community must provide success stories of how funding has had impact on the operations, education, and research mission fronts. All research and test reactors should work together show these funding agencies the various avenues in which contributions are being made and the role that is played in the critical national infrastructure. Open and transparent metrics which communicate different value across the community would aid customers in identifying potential alternatives to the government facilities. These metrics should value all aspects of the research process including but not limited to ease of access, license flexibility, staff support capability, unique systems, reactor power level, and student engagement to name a few.

While the challenges of Utilization and Relevancy are large, the relatively small number of competing facilities and close-knit nature of the research and test reactor community makes this area ripe for harvest in the coming years.

2.3 Path Forward – FY2020

The fitness study is intended to be a cooperative effort between NSUF (representing DOE-NE) and the US university research reactor community. In this spirit, the community is needed to provide input and analysis of their specific needs, priorities, and timelines. NSUF will incorporate these into the established infrastructure management activities that it performs on behalf of DOE-NE. The major output of those activities is the Annual Nuclear Energy Gap Analysis Report, submitted to DOE-NE in June 2020, for FY2020. This document is not publicly released based on the combination of data and recommendations.

2.3.1 TRTR Panel – September 2019

Two months after the NSUF workshop, the project team presented their interim work at a panel session during the 2019 TRTR Annual Meeting. The presentations given during that session are attached in Appendix C. The assembled research reactor community held a spirited discussion during the panel session. The substance of this will be included by the working group chairs in their specific areas. A representative from the IAEA referenced the extensive work that the Agency has done across the world that may be able to support this effort.

2.3.2 Study Report – December 2019

This report (INL/EXT-19-56309) is intended to be a description of the work that was performed in FY2019 on the Fitness Study. It is intended to be a public document, available to the research reactor community, and any other interested stakeholders. It does not contain any recommendations from NSUF, only a summary of the activities and preliminary input from the university working groups.

2.3.3 TRTR White Paper – April 2020

The four working group leads will coordinate the effort with the larger TRTR community to draft a white paper, based on the FY2019 work, with their main issues, priorities, timelines, and resource needs. This paper is expected to be delivered to NSUF no later than April 2020 so that it can be included in the

FY2020 gap analysis report. NSUF intends to include the entire white paper in the report, but may make recommendations based on all, some, or none of the content.

2.3.4 Gap Analysis Report – June 2020

The NSUF gap analysis captures infrastructure gaps and identifies investments to be made at the national laboratories via direct program funding or other funding mechanisms and recommendations for areas of investment at universities that can become focus areas in the university scientific infrastructure FOA. The recommended projects are developed in response to the DOE-NE request for information (RFI), surveys that were distributed to the national laboratories' DOE-NE points of contact, NSUF users, and Nuclear Energy University Program (NEUP) users, technology workshops, and other avenues. The University, National Laboratory, Industry and International Input on Potential Office of Nuclear Energy Infrastructure Investments (DE-SOL-0008318) is available through the NEUP website (https://neup.inl.gov/SitePages/Related_Documents.aspx). The RFI is usually open through May of each year to provide input to the NSUF gap analysis.

2.3.5 FY2021 CSIS FOA – July 2020

Focus areas for the infrastructure FOA can come from a variety of sources. NSUF uses the gap analysis to inform this FOA. It is expected that new areas of support for research reactors could come through this FOA. NSUF would make recommendations to DOE-NE, who have the final decision.

2.3.6 Outreach Efforts – Late CY2020

Presentation of the results of this study and any new policy approved by DOE-NE would be presented to the research reactor community at the 2020 TRTR Annual Meeting in Chicago, IL in September 2020 and to the larger nuclear community at the American Nuclear Society Winter Meeting and Nuclear Technology Expo in Chicago, IL in November 2020.

2.3.7 Program Review – FY2021

In order to review the progress of the program and any new initiatives, a periodic review should be performed. NSUF would perform this as part of the annual gap analysis process. TRTR can perform their own assessment and provide input to NSUF and/or DOE-NE.

3. REFERENCES

[1] D. Morrell, "2017 Status Report, DOE Research Reactor Infrastructure Program," in 2017 TRTR National Meeting, San Diego, 2017.

[2] D. Ogg, “Nuclear Energy’s University Programs,” Briefing for the Nuclear Energy Advisory Committee, Washington, D.C., March 28, 2019.

Page intentionally left blank

Appendix A

Survey Results

Page intentionally left blank

Appendix A

Survey Results

The summary data from the survey are presented here. Only a minimum of editing has been done to preserve the intent of the community in providing their input.

Infrastructure Topic Area

Control Consoles

Question	Yes	Percentage
Have you completed a full replacement of your control console in the last 10 years?	2	9%
Are you planning on completing a full replacement in the next 10 years?	9	40%
Are you planning a digital I&C upgrade?	9	100%

Major Infrastructure (not consoles)

Are there any upcoming big-ticket items at your reactor, other than consoles, that should be reviewed/discussed?

Reactor and Radiation Equipment	Civil Engineering	Other Infrastructure
Nuclear Instruments & Detectors(2)	Reactor Pool liner, concrete repair, liner replacement(4)	Hot cells, beam laboratory, other major experimental upgrade (4)
Reactor Safety System	Reflector replacement	Fuel storage location and cask
Control Rod Drives, magnets, blades, etc. (3)	Cooling system repair/upgrade(5)	Security/access control system
	Reactor Bay ventilation, Emergency exhaust (2)	
	Reactor bay crane replacement (2)	

Safety Equipment

Do you have any safety significant equipment for which you do not have spares?

Reactor and Radiation Equipment
Nuclear Instruments & Detectors(7)
Reactor Safety System (9)
Control Rod Drives, magnets, blades, etc. (9)
Continuous Air Radiation Monitors(4), Area Radiation Monitors (3)

Are there any safety (CAMS, detectors, etc.) or increased utilization upgrades (such as increased cooling/power level/Ar-41 mitigation) that could immediately benefit the reactor?

Reactor and Radiation Equipment	Civil Engineering	Other Infrastructure
Nuclear Instruments & Detectors(3)	Cooling system repair/upgrade(8)	Hot cells, beam laboratory, other major experimental upgrade (4)
CAM(8), ARM(5), survey instruments(2), portal monitor, personnel dosimetry, stack monitor	Reactor Bay ventilation, Emergency exhaust	Fuel storage location and cask
	Reactor bay crane replacement	Analysis help for power uprate (4)

Maintenance Support

Are there upgrades at your reactor needed to support future maintenance?

Reactor and Radiation Equipment	Civil Engineering
NI(legacy x2), Console parts, computer(10), chart recorders(3), BF3 and vacuum tubes	
Reactor Safety System	
Control Rod Drives, magnets, blades, etc. (4)	Cooling system repair/upgrade
CAM(2), ARM(2) (software & firmware)	Reactor Bay ventilation(2)

Are there any systems or components at your facility with chronic recurring issues?

Reactor and Radiation Equipment	Civil Engineering
Console (5)	Reactor Pool liner (2)
Nuclear Instruments & Detectors(6)	
Reactor Safety System (2)	
Control Rod Drives, magnets, blades, etc. (5)	
CAM, ARM(2)	

Do you have any current single point failures?

Reactor and Radiation Equipment	Civil Engineering
Console (3)	Cooling system repair/upgrade(3)
Nuclear Instruments & Detectors(6)	Reactor Bay ventilation (2), Emergency exhaust
Reactor Safety System (4)	
Control Rod Drives, magnets, blades, etc. (6)	
CAM (3)	

Regulatory and Licensing Topic Area

<u>How has RTR regulation changed over the last 10 years?</u> **- Security**

Regulatory Environment	Regulatory Burden
Source security & HEU, Security vs. capability to operate challenge(2)	Increased burden(4)

<u>How has RTR regulation changed over the last 10 years?</u> **- Inspections**

Regulatory Environment	Regulatory Burden
• Focused on details/not understanding(2), • Differences between inspectors, • Difference between NRC and facility interpretations, • Lack of understanding of RTR risks (2), • Rate of LER has increased due to NRC culture shift	• Focused on details (2), • Increased burden (5),

<u>How has RTR regulation changed over the last 10 years?</u> – **Minimum Regulation**

Regulatory Environment	Regulatory Burden
• Shift towards NPP-style regulation environment (3), • Regulations are written for NPP, not RTR-specific regs (2), • Disregard for "reasonable assurance", • Small RTR staffs make complying with a strict regulator challenging, • Need more Risk Informed regulation for RTR	• Shift towards NPP-style regulation (use of NPP experts for analyses)

<u>How has RTR regulation changed over the last 10 years?</u> - **Licensing**

Regulatory Environment	Regulatory Burden
• Slow responses(4) for: power uprates, digital I&C approval(2), requalification plans, • Shift toward M&S rather than operating data for LAR, • Still too many RFI cycles (2), • Technical capability of NRC staff is slipping (they need more funding)	• 10CFR50.59 process is challenging, • **Facility staying with old equipment rather than upgrading due to regulatory burden/risk(2),** • Increased burden(6), increased RAIs, • NRC staff is use of contractors(3)

<u>How has RTR regulation changed over the last 10 years?</u> – **Positive Responses**

Regulatory Environment	Regulatory Burden
• Less adversarial than in NPP sector, • Good environment and support, • Regulator makes a genuine effort to support RTR community, • Better communication with regulator, • Good working relationship with NRC and state • Does put RTR risk in context	• no change in licensing or inspection burdens(3), • Burden has increased, but the NRC branch has worked with the facility to succeed • Some of the increased burden was important to safety

Change Control

<u>Are there any significant regulatory challenges associated with Instrumentation and Control System upgrades that are beyond the capability of your facility?</u>

Expertise	• Human factors/HMI, • Electrical engineering,
10CFR50.59	Change documentation/10CFR50.59 expertise
NRC	• NPP bias in regulation • Short staffing at NRC
Staffing	Facility does not have staff for Digital I&C upgrade(7)

What process do you use to fill out and evaluate 10 CFR 50.59 facility changes?

Informal Procedure or Checklist (8)	Various methods
Formal Procedure (13)	• NEI-96-07(4), • NEI-01-01(), • EPRI guidance, • RG-1.187
Internal Preparation & Review	• Reactor Engineer, • List of qualified "preparers" and "reviewers", • Qualified staff • Reactor Safety Committee(3)
Comments	"only do upgrades that screen out"

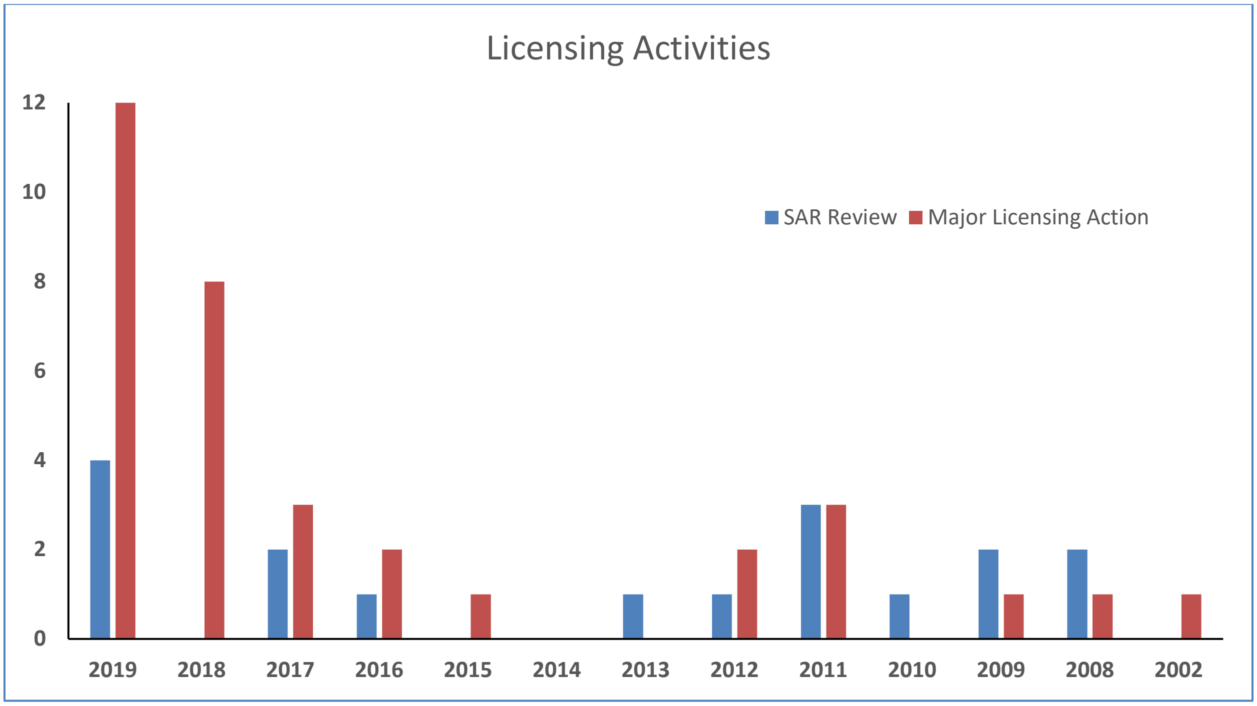
Licensing and SAR

What type of support does your facility need to be able to make the change to indefinite licensing successfully

Area of Need	Count	Percentage of Responses
Regulatory Compliance	8	32%
Technical (Legal) Writing	2	8%
Analysis Methods (RELAP)	3	12%
Contractor Help (for analyses)	8	32%
Additional Staff Support	4	16%
Good News	We already continuously update SAR(2), undergoing relicensing now without issue(2), no needs(4),	
Once the first revised SAR is submitted, would you like a lessons-learned review?	YES = 100%	

When was your SAR last reviewed?

When was your last major licensing action?



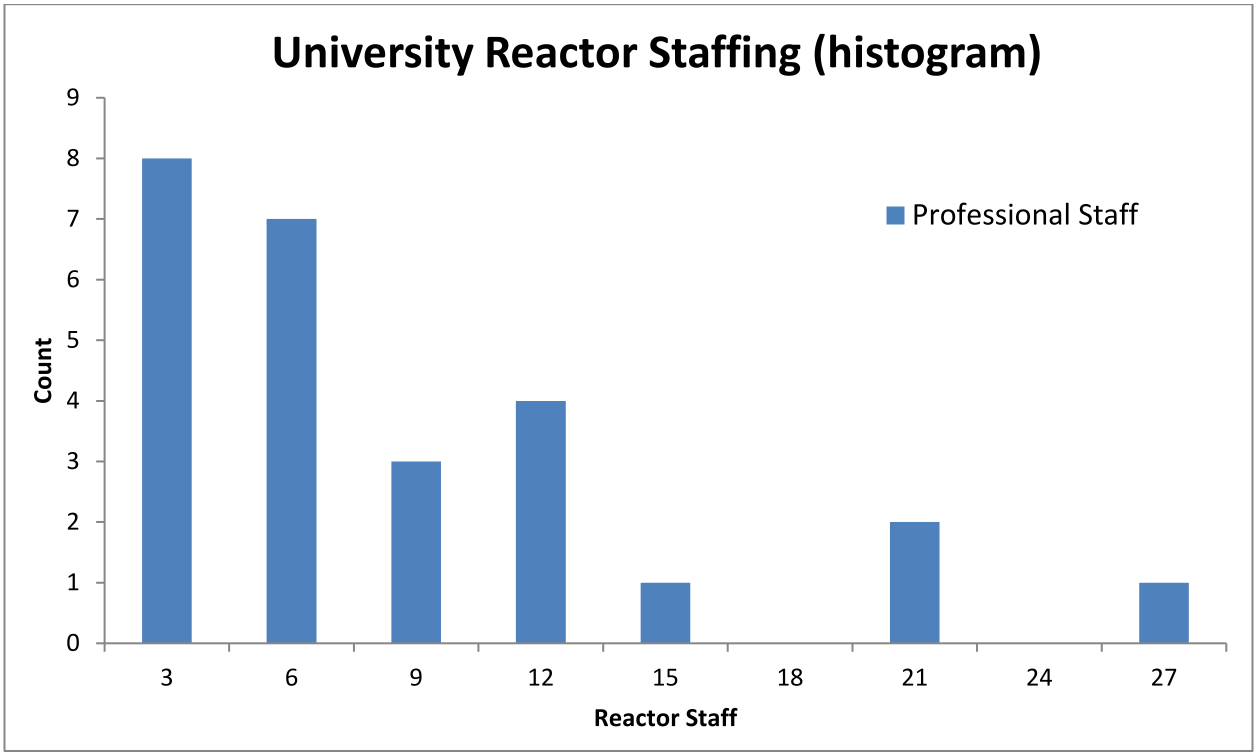
Staffing and Knowledge Transfer

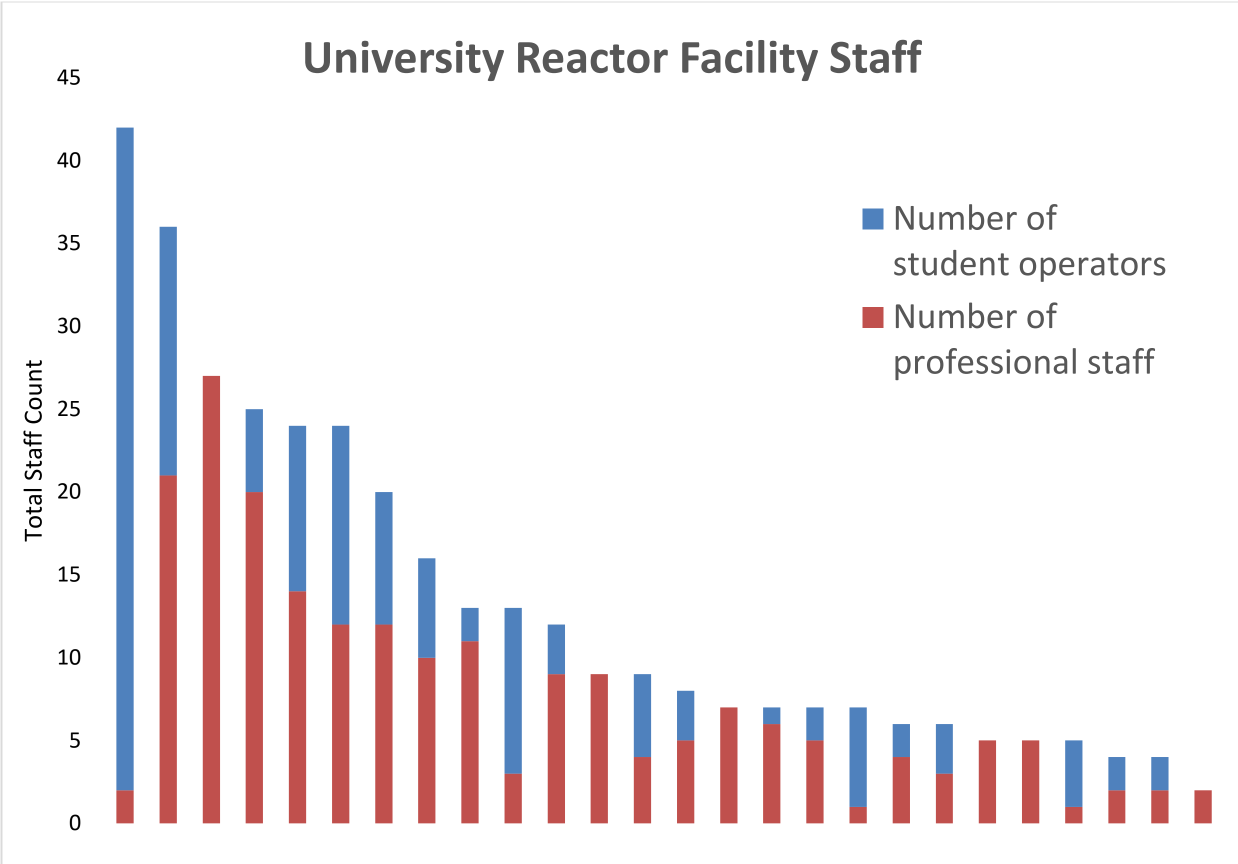
Staffing Changes

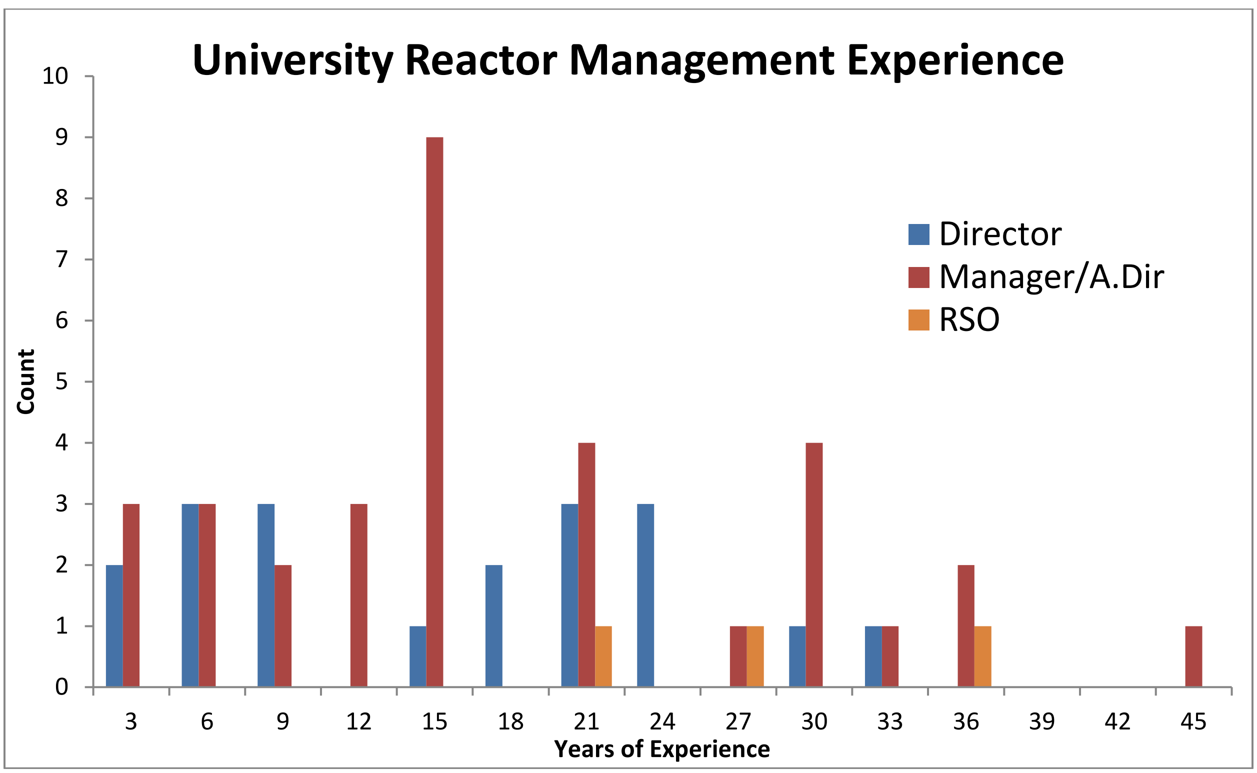
What changes do you see in the coming years for your facility staff?

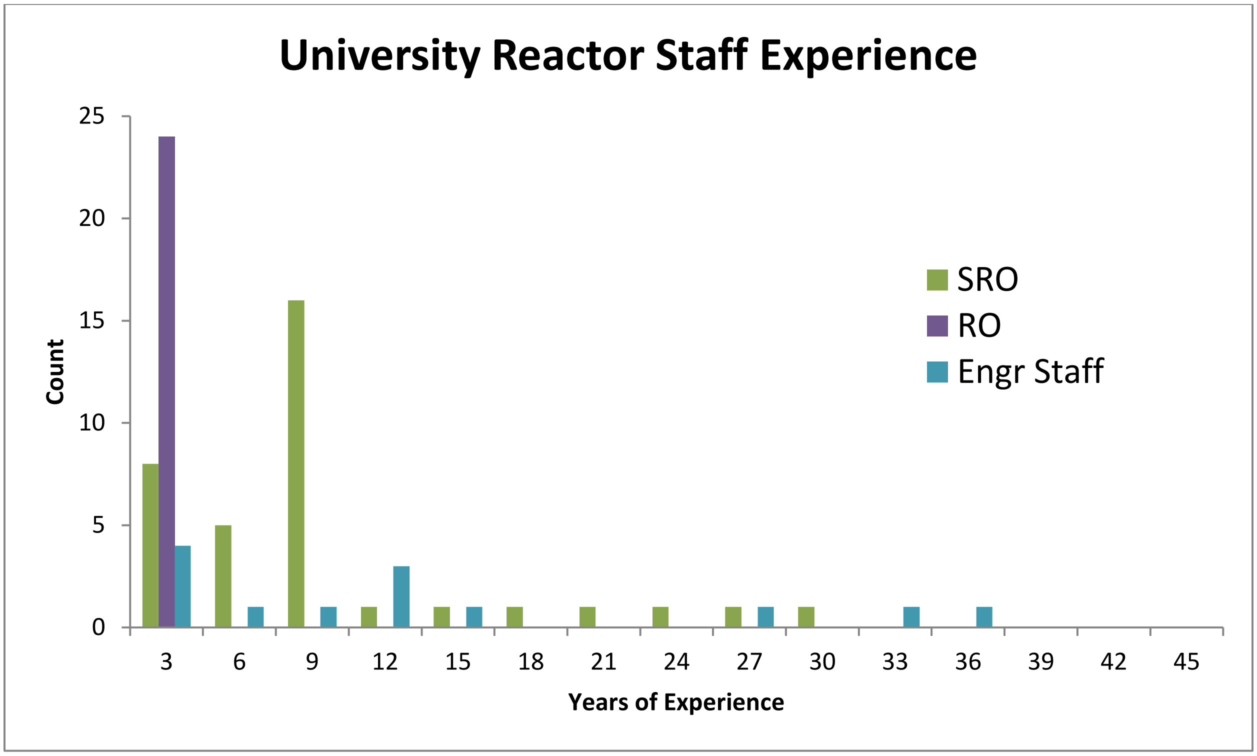
<table>
<tr><th colspan="2"></th><th>3 years</th><th>5 years</th><th>10 years</th></tr>
<tr><td colspan="2">Reactor Management</td><td></td><td>2</td><td></td></tr>
<tr><td colspan="2">Senior Staff</td><td>2</td><td>4</td><td>7</td></tr>
<tr><td rowspan="4">Rx Operations Staff</td><td>Normal Turnover</td><td>10</td><td>5</td><td>5</td></tr>
<tr><td>Increase Staff</td><td>3</td><td>3</td><td>2</td></tr>
<tr><td>No Change</td><td>2</td><td>3</td><td>1</td></tr>
<tr><td>Big Losses</td><td>1</td><td></td><td></td></tr>
<tr><td colspan="2">Student Operators</td><td>4 + increase to accommodate growth</td><td>1</td><td>1</td></tr>
</table>

	3 years	5 years	10 years
Research Staff	increase to accommodate growth (5)	increase to accommodate growth	increase to accommodate growth

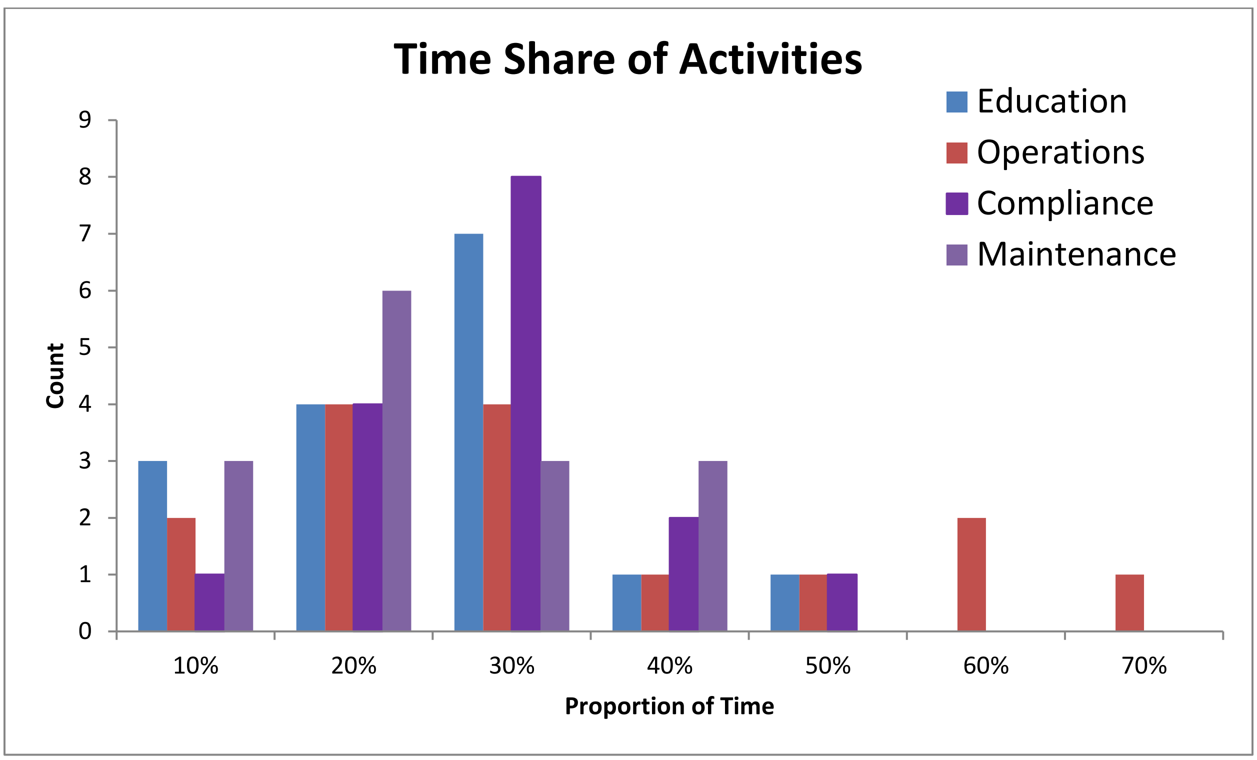



University Reactor Facility Staff
45
40
35
30
25
20
15
10
5
0
Total Staff Count
Number of student operators
Number of professional staff


University Reactor Management Experience
10
9
8
7
6
5
4
3
2
1
0
Count
Director
Manager/A.Dir
RSO
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
Years of Experience



University Reactor Staff Experience
Count
25
20
15
10
5
0
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
Years of Experience
SRO
RO
Engr Staff



Time Share of Activities
Count
9
8
7
6
5
4
3
2
1
0
10%
20%
30%
40%
50%
60%
70%
Proportion of Time
Education
Operations
Compliance
Maintenance

Knowledge Transfer

Does your facility have a succession plan?	
YES	**NO**
14	13
52%	48%

Are you active in the TRTR community?	
YES	**NO**
20	6
77%	23%

<u>Do you have the resources to perform a major licensing action coincident with a major facility update?</u>

Yes	Maybe	**No**			
		Need external technical help	Need regulatory help	Need more staff in general	Couldn't handle one LAR
10	**4**	**6**	**2**	**2**	**3**
37%	15%	22%	7%	7%	11%

What sort of help could your facility use with respect to staffing and/or knowledge transfer?

Area of Need	Count	Percentage
More professional staff (including skilled trades)	7	20%
Research funding (would grow staff naturally)	3	9%
Regulatory support funding	3	9%
Student training support funding	1	3%
Database of professional staff (hiring pool) and expertise	2	6%
Staff support for off-site training	2	6%
Connections to other TRTR facilities	1	3%
Standardized resource (SAR, Technical Specifications, analyses, Operation and Maintenance)	2	6%
Continued (increased) infrastructure support	10	29%

Appendix B

ThinkTank Report from Workshop with Presentations (July 2019)

Page intentionally left blank

Appendix B

ThinkTank Report from Workshop with Presentations (July 2019)

University Research Reactor Fitness Workshop

July 16-17, 2019

Idaho National Laboratory

Participants

Organizer

Brenden Heidrich, *Department of Energy*

Facilitators

Alison Conner, *Idaho National Laboratory*

Jodi Grgich, *Idaho National Laboratory*

Attendees

Amber Johnson, *University of Maryland*

Leslie Foyto, *University of Missouri, MURR*

Andrew Kauffman, *Ohio State University*

Lin-wen Hu, *Massachusetts Institute of Technology*

Ashoak Nagarajan, *Idaho State University*

Matthew Lund, *University of Utah*

Bruce Meffert, *University of Missouri, MURR*

Melinda Krahenbuhl, *Reed College*

Clive Townsend, *Purdue University*

Paul Michael Whaley, *University of Texas - Austin*

Corey Edwards, *University of Wisconsin*

Sarah Don, *Massachusetts Institute of Technology*

Ethan Taber, *Missouri University of Science and Technology*

Scott Lassell, *North Carolina State University*

Jeffrey A. Geuther, *Penn State*

Steven Reese, *Oregon State University*

Lei R. Cao, *Ohio State University*

Thomas Regan, *UMass Lowell*

Objective

Discuss and assess the fitness and needs of the Nation's university research reactors and develop recommendations for future development.

Agenda

Tuesday, July 16

Center for Advanced Energy Studies (CAES) Auditorium (2nd Floor)
995 MK Simpson Boulevard, www.caesenergy.org

7:45 Computer Network Setup .... CAES IT Staff

8:15 Welcome and Introductions .... Sean O'Kelly
Associate Laboratory Director for the Advanced Test Reactor / TRTR Chair

8:20 Department of Energy Perspective .... Kenny Osborne
Program Analyst, Department of Energy-Office of Nuclear Energy

8:25 Workshop Organization .... Brenden Heidrich
NSUF Chief Scientist, Irradiations

8:30 **University Reactor Infrastructure Session** ....

8:30 – Summary of Survey Results .... Brenden Heidrich
NSUF Chief Scientist, Irradiations

8:45 – Infrastructure Success .... Lin-wen Hu
Director, Research and Services, MIT Nuclear Reactor Laboratory

9:00 – Infrastructure Success .... Les Foyto
Associate Director, Reactor and Facility Operations, MURR

9:15 – Infrastructure Success .... Jeffrey Geuther
Associate Director for Operations, Pennsylvania State University

9:30 – Infrastructure Challenge .... Matthew Lund
Reactor Supervisor, University of Utah

9:45 – Infrastructure Challenge .... Amber Johnson
Director, University of Maryland

10:00 – Infrastructure Challenge .... Ashoak Nagarajan
Idaho State University

10:15 *Break*

10:30 – Infrastructure Needs Discussion .... Alison Conner
Systems Analyses & Engineering, INL

11:00 **Licensing and Regulatory Compliance Session** ....

11:00 – Summary of Survey Results .... Brenden Heidrich
NSUF Chief Scientist, Irradiations

\

11:15 – Regulatory/Licensing Best Practice ....Clive Townsend
Reactor Supervisor/Assistant Lab Director, Purdue

11:30 – Regulatory/Licensing Challenge .... Steve Reese
Radiation Center Director, Oregon State University

11:45 – Regulatory/Licensing Discussion ....Alison Conner
Systems Analyses & Engineering, INL

12:15 Working Lunch "***INL's 52 Reactors***" presentation................................. Joseph Campbell
Nuclear Energy R&D Communications, INL

13:00 **Staffing and Knowledge Transfer Session**..

13:00 – Summary of Survey Results .... Brenden Heidrich
NSUF Chief Scientist, Irradiations

13:15 – Staffing/Knowledge Transfer Challenge ....Andrew Kaufmann
Sr Associate Director of NRL, The Ohio State University

13:30 – Staffing/Knowledge Transfer Best Practice ....Andrew Kaufmann
Sr Associate Director of NRL, The Ohio State University

13:45 – Staffing/Knowledge Transfer Challenge .... Jeffrey Geuther
Associate Director for Operations, Pennsylvania State University

14:00 – Staffing and Knowledge Transfer Issues ....Sarah Don
Superintendent for Reactor Operations, MIT

14:15 – Staffing and Knowledge Transfer Discussion ....Alison Conner
Systems Analyses & Engineering, INL

14:30 *Break*

14:45 **Utilization and Relevancy of URR Session**..

14:45 – Summary of Survey Results .... Brenden Heidrich
NSUF Chief Scientist, Irradiations

15:00 – Utilization Success .... Melinda Krahenbuhl
Reactor Director, Reed College

15:15 – Utilization Success ....Scott Lassell
Manager of Nuclear Services, Nuclear Reactor Program, NCSU

15:30 – Relevancy Challenge .... Lin-wen Hu
Director, Research and Services, MIT Nuclear Reactor Laboratory

15:45 – Relevancy Challenge .... Les Foyto
Associate Director, Reactor and Facility Operations, MURR

16:00 – Utilization and Relevancy Discussion .... Alison Conner
Systems Analyses & Engineering, INL

16:30 Adjourn for the day

Wednesday, July 17

Center for Advanced Energy Studies (CAES) Auditorium (2nd Floor)
995 MK Simpson Boulevard, www.caesenergy.org

8:00 Working group organization and expectations (Auditorium) .... Brenden Heidrich
NSUF Chief Scientist, Irradiations

Parallel Working Group Meetings 1

8:15 Infrastructure Working Group (Auditorium) .... Alison Conner
Systems Analyses & Engineering, INL

8:15 Licensing and Regulatory Working Group (Teton Conference Room) .... Jodi Grgich
Systems Analyses & Engineering, INL

Parallel Working Group Meetings 2

9:15 Staffing and Knowledge Transfer Working Group (Auditorium) .... Alison Conner
Systems Analyses & Engineering, INL

9:15 Utilization and Relevancy Working Group (Teton Conference Room) .... Jodi Grgich
Systems Analyses & Engineering, INL

10:15 Break

10:30 Working Group Reports by Chairmen/Voting/Recommended Solutions...... Alison Conner
Systems Analyses & Engineering, INL

11:50 Path Forward and Closing Remarks (Auditorium) .... Brenden Heidrich
NSUF Chief Scientist, Irradiations

Welcome

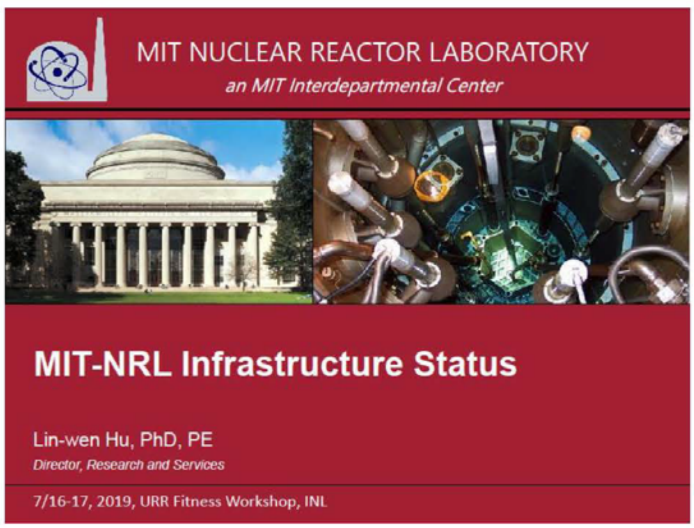
INFRASTRUCTURE

University Research Reactor Fitness Workshop

1. What is the estimated cost for a new console? $1M-$1.5M to $2M-$2.5M. A recent upgrade cost about $1.25M which was very conservative and cost the vendor to meet

the commitment. These estimates don't include university labor hours to implement the upgrades
2. It takes 18 months - 2 years to get parts.
3. Key challenge is ability to do this in-house; drives preferred vendor.
4. Move towards digital is getting to the point that can't manage everything.
5. Look at implementing part digital and part analog; upgrade at different times; much higher reliability.
6. Suggestion to develop a generic console version with add-ons.
7. A common design could help control costs.
8. If 9 reactors, for example, need new consoles, that's a value that someone (DOE) needs to know. This could be a key item in this report; identification of where investments should be made.
9. There is a DOE emergency fund, as needed.

INFRASTRUCTURE: MIT Nuclear Reactor Laboratory



Slide 1

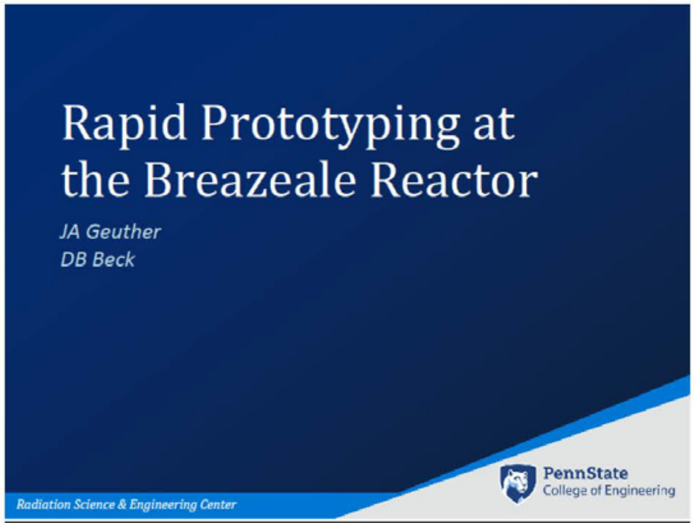
1. Q&A Session: Took 11 years to get NRC license for a 6 MW (LWR) reactor.
2. Can't shut down for 18 months; would significantly impact program.
3. Staffed by Lin-wen Hu plus students, approximately 4 FTE total.
4. Delay on NRC end was very impactful.

INFRASTRUCTURE: University of Missouri-Columbia Research

Slide 1

1. Q&A Session: If required to shut down for 6 weeks, program might not last.
2. Push back by NRC? No, done through 50.59
3. As reactors operate past design basis lifetime, failures that were never considered are starting to show up.

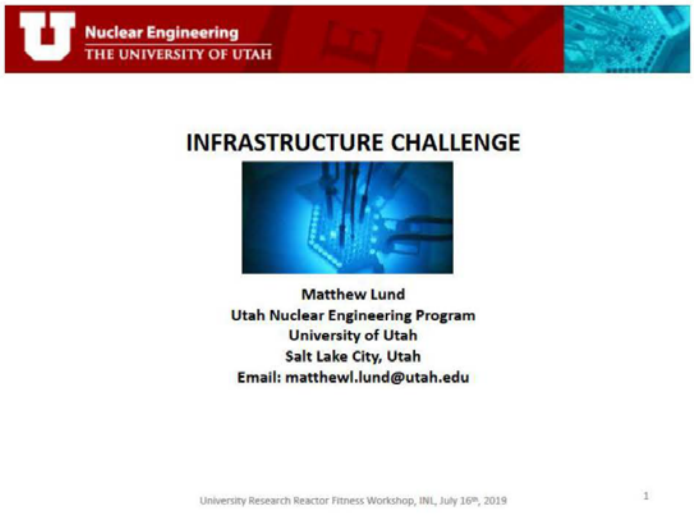
INFRASTRUCTURE: Penn State



Rapid Prototyping at the Breazeale Reactor

1. Does Penn State have resources to do 3D metal printing? Unknown
2. The Ohio State University has capability to print 3D in plastic and metal.
3. Does this force you to start using CAD in design documents? Maybe

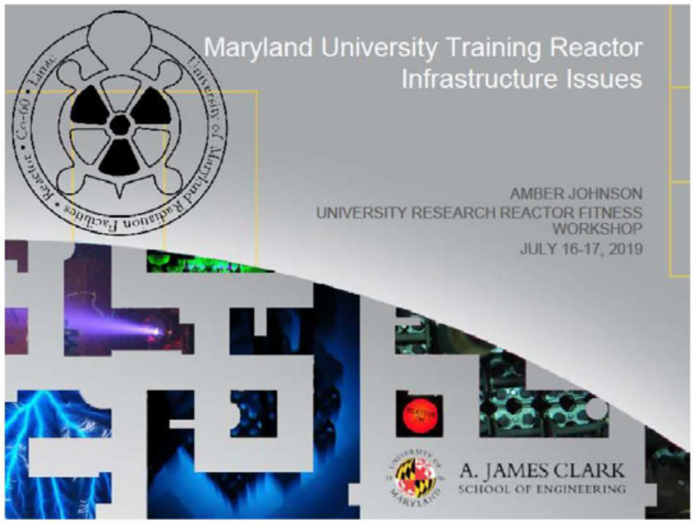
INFRASTRUCTURE: The University of Utah



Slide 1

1. Down for about 1 year waiting for a new neutron channel.
2. Cooling system not used in last 10 years.
3. University of Utah has a 5-10 Year Roadmap.
4. Has 2 instrumented fuel rods that scram on high fuel temperature; similar to Oregon State's reactor.
5. Currently has 2 spare 8.5 fuel elements.
6. Licensed to 72 slots, but has more available; considering mixed core for future analysis
7. Installation side by side might be a red flag to a regulator; Utah chose to do it this way to enable ease of calibration.
8. In process of completing the 50.59.
9. Decreasing chamber channels also might be a red flag; reduction desired due to 4th channel not needed nor required in tech spec.

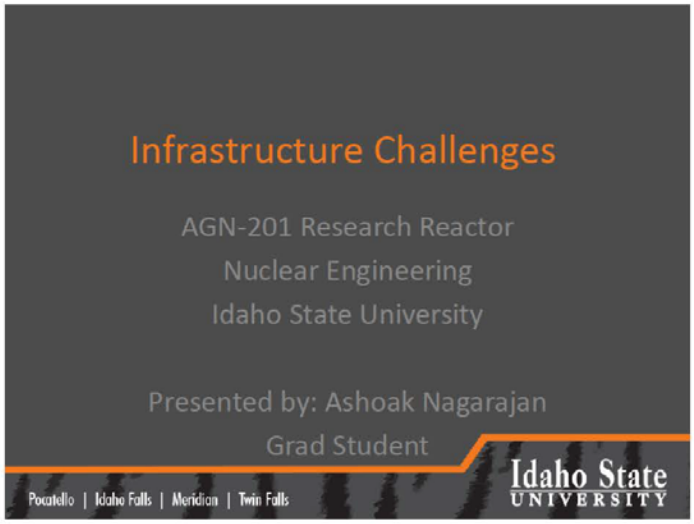
INFRASTRUCTURE: Maryland University



Slide 1

1. Staffed by Amber plus 2 staff members; plan to license 6 student operators in the Fall.
2. Cable management was not done well in the past; need to clean this up.
3. There is lots of noise on the signals that needs to be cleaned up.
4. Primary coolant system is all visible for inspection.
5. During re-licensing, it was identified that they can't run fans in the HVAC system; think this is in tech spec in around section 3.4.; it has something to do with how things were worded.
6. Cost savings idea for Amber was to reuse old paper.

INFRASTRUCTURE: Idaho State University



Slide 1

1. Rod drive motor is single point of failure.
2. Vendor no longer exists; 50 drawings generated for the design, but ISU doesn't have all of them; need to upgrade drawings and hardware; taking pictures of drawings due to fragile original drawings.
3. Upgrades will remain as analog.
4. There are 3 reactors with similar challenges: ISU, University of New Mexico, and Oregon State.

INFRASTRUCTURE Challenges: Facilitated Session

1. Equipment Aging
2. Equipment Obsolescence
    a. Manufacturer goes out of business
3. Civil Engineering (building) issues
    a. Create DOE funding resource for basic infrastructure, such as replacing building electric.
4. Digital Console Conversion
5. Critical Spare Parts
    a. Allow for purchase of spares in equipment grants.
6. Equipment installed in the 1960's had a lifetime of 40 years, but equipment being installed today only seems to have a lifetime of 10-20 years. It's also taking longer and longer to get engineering and system installations done because of 1. vendors and 2.

regulatory approval. This is not sustainable. At some point we won't be able to replace anything. If it becomes only a matter of survival for RTRs then we're not doing anything innovative, and our purpose and contribution to nuclear power and research becomes questionable.

    a. Allow for purchase of spares in equipment grants.

7. No longer apply for more than 1 no cost extension (FOA)
    a. Ask for multiyear project up front / proposal
        i. Before writing grant, a target vendor should be determined and tentative timeline with them as to what's realistic.
8. Lead time in getting parts
9. Difficult to spare staff time to implement upgrade
    a. Include students
    b. NEUP allow funding to be spent internally within campus, perhaps with constraints on how it can be spent.
        i. This would also allow use of campus-based resources, such as fabrication and machining facilities.
        ii. This would also allow coverage for fees if there are any for university facilities management of project.
        iii. Maybe set max percentage that could be spent on lab staff.
    c. For complicated upgrades, have proposal opportunities for design stage of upgrade.
10. Basic infrastructure i.e. building electric
    a. Pull best practices from other technical communities (i.e. cable management)
        i. workshop opp
            1. i.e. experience from research org to eliminate noise
        ii. University to university
        iii. Recommended sensors and components list of reliable, lower noise
            1. Build web app
11. Who's responsible?
12. Process for identifying spare parts and which to replace first
    a. IAEA program update
13. Nothing is off-the-shelf
    a. Need standard, basic off the shelf
    b. Basic model with option packages
    c. Work with vendors upfront, how to pick a vendor, etc.
14. Disappearing vendors
    a. Successful vendors list
        i. Been through 50.59
    b. F&OR up-front streamlined build
    c. Develop template(s)
    d. Template for specs & scope of work
    e. Weekly status with vendor

f. PM set up

15. Licensing uncertainty
    a. Plan ahead for major system upgrade, such as primary coolant system, nuclear safety system upgrade to avoid extended shutdown
16. Know where bar is set - expectations
17. Lack of expertise
18. Not using lessons learning or having them available to community
    a. Reach out to others for review and guidance
    b. Share specs with each other
    c. Standard design criteria
    d. Identify lifetime components replacement schedule
    e. Establish preventative maintenance program
    f. Equipment replacement matrix
    g. Separate cost/support to maintain reactor and experiments
    h. DOE fellowship program to support infrastructure
    i. Form TRTR working group at annual meeting to review member experience and establish best practices and guidelines for infrastructure upgrades and maintenance.
19. DOE Infrastructure program does not recognize the difference between operational facility infrastructure and experiment infrastructure; this puts items/equipment necessary to keep the facility operating in competition with equipment for experiments to be conducted in the facility
    a. Use a three-tier system, applicants allowed to make a proposal in each tier; tiers would be (1) necessary to keep the facility running, (2) upgrades to the facility systems and equipment to improve operability or safety, and (3) research equipment

REGULATION AND LICENSING

Slide 1

1. Can we form group to train NRC inspectors for RTRs? Need to look at new requirements; this could be a workshop opportunity; could use archived analysis, documents, drawings, etc.
2. NRC not interested in an envelope type license; want to license specific reactors.
3. Culture challenge at NRC.

Survey Summary

1. Would be curious if the missing two facilities are under threat of closure? Why didn't they participate?

How Has RTR Regulation Changed Over the Last 10 Years? – Inspections

1. How are people preparing for inspections?

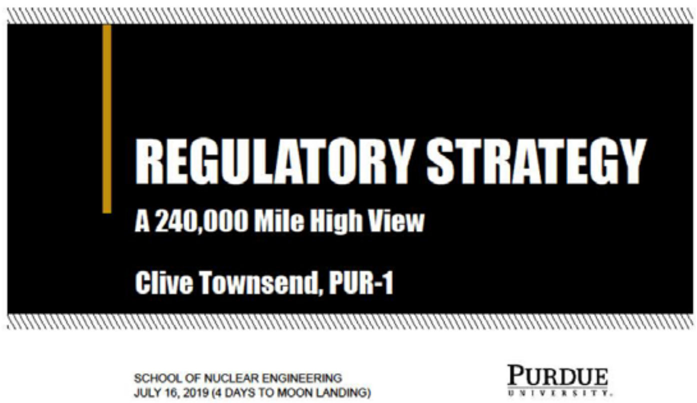
How Has RTR Regulation Changed Over the Last 10 Years? – Licensing

1. Would challenge the technical capability statement especially with regards to DI&C

Licensing and SAR

1. I believe the NRC reports to Congress quarterly regarding this backlog
2. They have mentioned in private that congressional reporting is a growing draw on staff time

REGULATION AND LICENSING: Purdue University



Regulatory Strategy

1. Invited entire licensing team to reactor location; Phase zero status meetings were held every 2 weeks via telecon.
2. Wrote re-licensing application by answering questions that the regulatory had to answer.
3. No inspectors guide for I&C.
4. Took 2 years to get approved; about 6 months was due to Clive's other priorities.
5. Worked hard upfront to nail down requirements.
6. Worked directly with NRC regulator.
7. Used common components; has a parts list and recommended backups.
8. Reactor with start up in August 2019; vendor wrote site acceptance testing; NRC had access to acceptance testing.
9. Real Time Products (RTC) PLC already approved by NRC for power plants
10. https://www.rtpcorp.com/apps-nuclear.htm

REGULATION AND LICENSING: Oregon State University

Slide 1

1. Took 6 months to get safety limit change approved.
2. FYI, Dowell's facility pulses without an IFE.

Proposed LAR for Pulsing without an IFE

1. Lack of contact with OGC to TRTR is a major issue
    a. This is popping up a few times... Getting interpretations about minimum staffing, "may" / "shall" / "should" etc.
    b. From the OSU presentation, sounds like there are hints that the NRC staff are also frustrated
2. This is another good point. The people with the most knowledge of the community as a whole are in Rockville
3. NRC has prioritized LARs with critical "we'll be out of business" timelines a couple times I believe

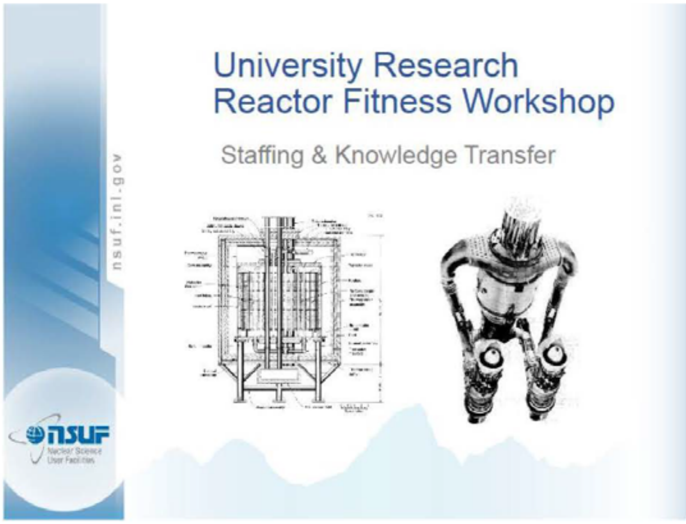
REGULATION AND LICENSING Challenges: Facilitated Discussion

1. Minimum Regulation
2. Burden is a drain on facility resources
    a. Need more staff to accomplish this. The additional staff could come from DOE support with their Reactor Analysis Group to help with computation, funding to hire contractors, or perhaps creating compliance assistance/trainers available to TRTR community.

        i. Having a group that could be gone to for help with SAR analysis would be very helpful.
    b. Something students might be able to help with, even if they're not operators, you could possibly hire them as an intern to write parts of an LAR.
    c. Disproportionate Impact on smaller facilities
        i. Letters from the TRTR community to the NRC painting the picture of burden and cost that they are imposing on RTRs.
3. Timely resolution of inconsistencies in regulatory interpretations
    a. Docketed letters to the NRC asking for clarification
4. Uncertainty and perception of risk
    a. Making facility changes
        i. NRC individual's preferences expressed as requirements
        ii. Multiple interpretations of regulatory requirements by inspectors and/or program managers
            1. Develop close relationships with program managers, inspectors, and examiners so that everyone is on the same page.
        iii. Utility of 10CFR50.59 process for changes
            1. Develop a simple internal screening process that is formally documented so you have a record when the inspector asks for it.
                a. A simple process is very helpful for this situation, but even the time spent for this adds up.
                b. It helps if your SAR is as general and vague as possible
            2. Look at what other reactors have done and use their methods to develop an internal process. Don't reinvent the wheel if possible.
        iv. Reluctance to make major upgrades to equipment
            1. Find equipment already approved for use by the NRC at another facility.
            2. Only upgrade within the bounds of 50.59
            3. See what other Universities have done and follow suite, don't reinvent the wheel if you don't need to.
            4. NRC use of (NPP) contractors for licensing reviews
                a. Challenge the NRC on RAIs that seem to have no regulatory basis.
                b. TRTR community needs to work with NRC to come up with contractors that are from the TRTR community that understand it.
                c. Working with PM to ensure draft of RAIs helps to eliminate redundant and non-relevant RAIs
            5. Lack of internal SME for analysis to support LAR/SAR work (contractor vs. training)
                a. NRC should look at risk more holistically rather than site specific. This may encourage more "common SAR" approaches to licensing

b. Licensing new operators
    i. Licensing student operators (non-binary gender students, 12 months RO experience before SRO exam despite relevant experience, gender bias during examination, etc.)
        1. Communication with examiner prior to exam about what to expect and what you can do to help convey the information they need
        2. We wrote a complaint letter to the NRC about enforcing 1 year of on-site experience for SRO candidates even when they do have ample prior nuclear/operator experience. This is also excessively burdensome for some of the smaller RTRs.
    ii. Multiple interpretations of regulatory requirements by inspectors and/or program managers
c. Communicating with NRC
d. Some NRC program managers overreact to preliminary information communicated informally

STAFFING AND KNOWLEDGE TRANSFER



STAFFING AND KNOWLEDGE TRANSFER: Ohio State University

THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

OSU Nuclear Reactor Laboratory

Staffing Challenge

Slide 1

1. Only facility that isn't under 14.38, but don't know why; submitted in 1999 and approved in 2008.

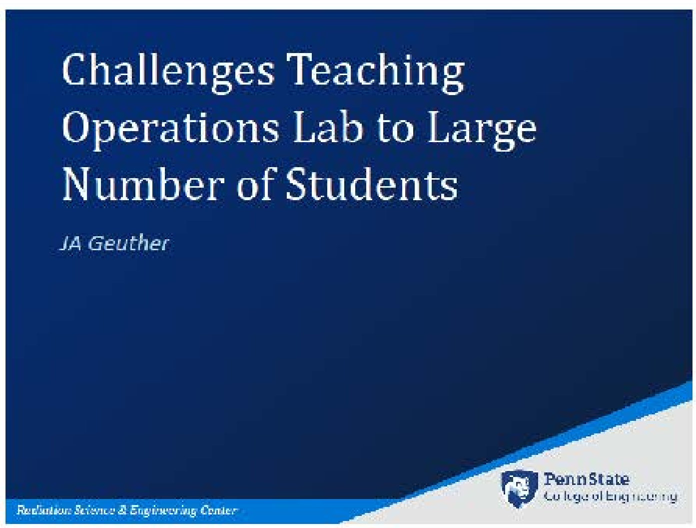
OSU-NRL Challenge: Staffing

1. Just thought of this... But do we have ability to share "access lists" to lessen the burden when visiting each other's facilities and other SGI / SGI-M?

Slide 1

1. Implemented a strategic plan that was used to justify hiring administrative support staff.
2. Identified list of external SMEs that can be called upon for help.

STAFFING AND KNOWLEDGE TRANSFER: Penn State



Slide 1

1. Updating console.
2. Suggestion was to change lab sequence offering; currently have 4 sections; potential to add a summer section; use of 3 TAs helps
3. Willing to share Graphite Pile labs? Yes

STAFFING AND KNOWLEDGE TRANSFER: MIT NRL

Slide 1

1. Operates 24/7 with minimum number of required staff-1 shift supervisor and 1 operator; would like to add 1 more person if funding allowed.
2. Website updates help with knowledge transfer, outreach, historical information, and user information.
3. QA Supervisor is monitoring QA files for completeness and action items follow up; files are physical.

Documentation

1. What do you use to manage to exam question bank?
    a. *An internal web interface, but there are apps/websites that will save question banks and randomize exams for you.*

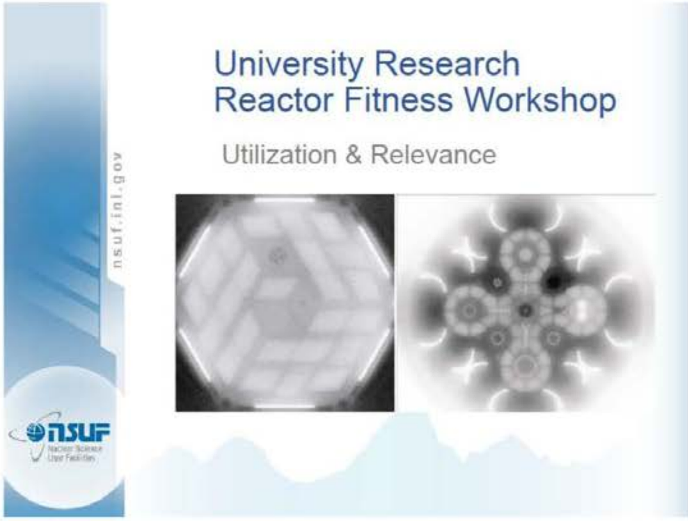
STAFFING AND KNOWLEDGE TRANSFER Challenges: Facilitated Discussion

1. Recruiting and keeping permanent staff
    a. Merit raises where possible
    b. Clear career trajectory
    c. progression plan
    d. Share professional development tasks and share boring tasks
    e. Need an advocator who understands reactor and is on the chain of command to talk to the upper management (department, college, or university, or state) for a large salary increase, often need to revise position description or change job title.
    f. Allow experienced staff to pursue projects of interests to him/her, and to participate in professional meetings
2. Utilization of students (operators + ???)
    a. Give individual students the opportunity to develop ownership through building a niche area of technical expertise
        i. An issue is presented, however, in needing to provide thorough oversight, especially as the student may not be considered technically qualified.
        ii. And by the time they possibly are they leave
    b. Hire students as operators
        i. This has been fairly effective for our facility, but funding can be hit or miss.
        ii. We typically have a one-year student training period, and the majority of the trainees are freshmen or sophomores. If we get two years of operations out of a student, we have felt that it is an acceptable time investment on the part of the staff.
        iii. While it is effective, it is a short-term fix - they are students and it is in their nature to move on to new jobs within a year or two of licensing.
        iv. Do you put GPA cap?
    c. Hire students to do research
    d. Hire students to work on solving a problem the reactor might be working on, or to design a new instrument or program.
    e. Encourage students to participate in research and/or special projects which would enrich their learning experience and offer professional/academic growth opportunities.
3. Succession and Knowledge Retention planning
    a. Video record requalification lectures so that they are available to absent personnel
    b. Videos of regular maintenance activities
        i. Videos must be kept brief, or they become counterproductive.
    c. Quality Assurance Program to save pieces of information important for system upgrades, instrumentation, equipment procurement, etc.

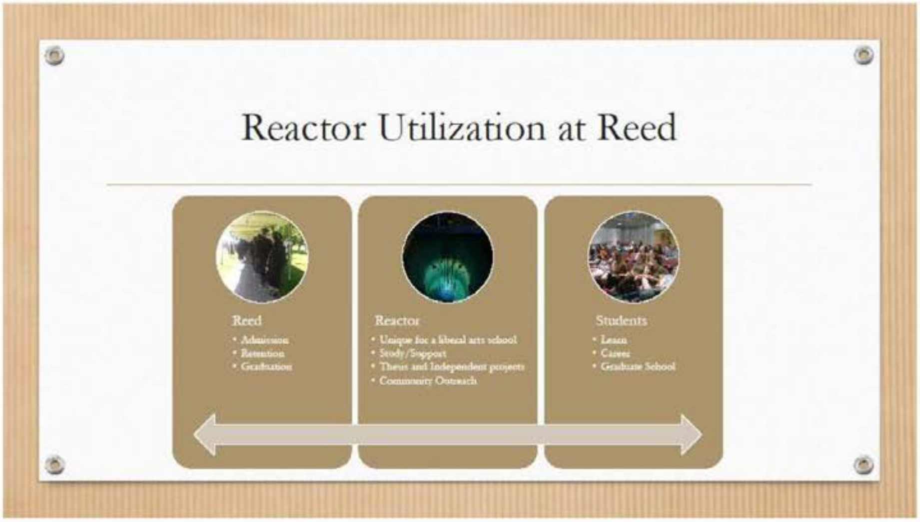
   d. Don't let a single staff member monopolize specialized knowledge...have a backup for every task
      i. Assign underling to a mentor to help with knowledge transfer. This is especially helpful when the mentor with the knowledge is resistant to documentation.
   e. Creating CANVAS (Learning Management System) training courses and documenting information in a facility WIKI.
   f. Create career advancement opportunities for staff
4. SME staff vs. Flexibility
5. Access to external SME resources
   a. Need to locate local SME - Alumni tend to be loyal and interested in supporting their institution
   b. Make use DOE and TRTR community help. They may not be able to personally be the SMEs, but they will have SME contacts who can help.
      i. Would they be available for third-party reviews?
   c. Suggest TRTR maintain directory of SME within the community
      i. This would be helpful. May want means built in for each SME resources to reaffirm desire to remain in directory.
6. Standardized safety analyses, etc.
   a. Formalized process for safety evaluations and unusual occurrence reporting
   b. https://trtr.org/index.php/technical-documents-for-reactors
7. Not enough staff members.
   a. Use of strategic plan to communicate needs with university.
      i. Sometimes university is not willing to help though...
8. Tracking staff member tasks and assignments.
   a. Trello
      i. Kanban boards in general are exceptional for tracking facility needs, projects, etc.
   b. Slack
   c. Any.do
   d. nTask
   e. Google Calendar for schedule-sensitive coordination of day-to-day tasks (this is what we use) and google sheets for keeping track of tasks like procedure updates, audit follow-up actions, unusual occurrence report action items, etc.
9. Ease of fuel shipment/receipt
   a. Make use of external help available through DOE (plus FLIR contractors)
10. Organizing all the documentation
   a. QA and Electronic Document Management System (EDMS), Document Controller (role)
      i. We have found moving historical records to pdf has helped us search for old info. Paper records are then archived in a university run repository.
      ii. This is the same thing we do except with a state archive

        iii. In addition to creating digital versions of regular documentation, we have made a goal of getting our decades-old drawings scanned.
    b. What Sarah said
        i. I want to see what MIT is doing!
        ii. Ditto
    c. Use of software such as MAXIMO that has the capability of supporting a Corrective Action Program, scheduling preventative maintenance and TS surveillances, Work Orders, audit scheduling, etc.
        i. Agree with using a CAP program that triggers review of not completed tasks.
        ii. Creating facility WIKIs and Learning Management Courses for documentation, QA programs, etc...
    d. Create an index on paper, then the order of files doesn't really matter because you'll be able to find which file the info is in
    e. Create a database for a documentation index
    f. DOE conduct of operations document https://www.directives.doe.gov/directives-documents/400-series/0422.1-BOrder-chg2-admchg/@@images/file
11. Determining when things (old documents) should be trashed
    a. Establish records retention policies and follow through
    b. Follow TS and develop an internal procedure for when TS doesn't apply. Digitize prior to disposal.
    c. Set a yearly week to go through records and dispose of old records as a required task.
    d. American Nuclear Insurer also has additional guidelines for records retentions that should be included.
    e. What other software alternatives are being used by facilities that are smaller scale and have much of the same functionality?
12. Maintaining support for tours with no reactor sharing funding.
    a. This one is tough. I've started blocking out periods when we don't have the staffing, or things are too busy, and we just ask prospective visitors to choose another time when we can support their visit.
13. Dedicating staff resources to major upgrades and license changes
    a. retain/maintain staff/students who have experiences with facility safety analysis
    b. establish workgroup within TRTR to share major upgrade and license changes experience.
14. Student recruit - where to recruit, nuclear versus non-nuclear student pool. Who does it, dedicated reactor staff or department unit?
    a. need to contact students as early as possible in academic career. Training time and effort often squandered on junior/senior level students as they often leave/graduate before being functional and contributing to org.
15. staff support for large item infrastructure or equipment upgrade
    a. quality assurance documentation

UTILIZATION & RELEVANCE



UTILIZATION & RELEVANCE: Reed College



Slide 1

1. Biggest challenge is regulation.

2. Reed is very supportive of the diverse research program; replaced cooling tower for Melinda.
3. Key to success is building relationships; with students, faculty, staff, management.
4. Retention rate of students in this program is higher than any of the others at Reed.

UTILIZATION & RELEVANCE: North Carolina State University

Slide 1

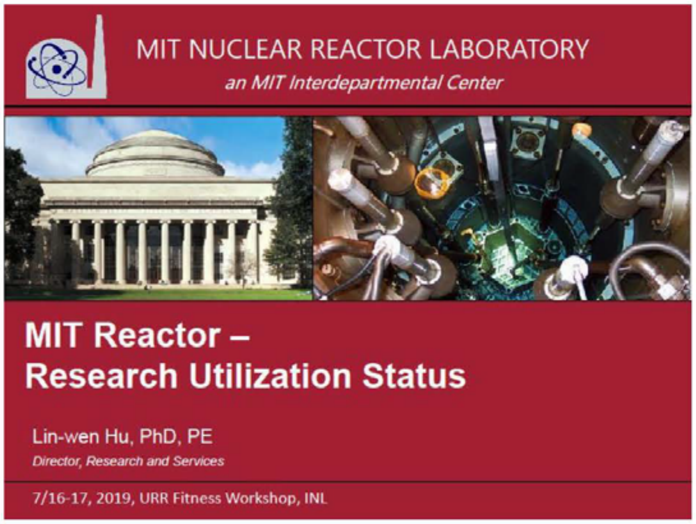
1. Acceptance of remote experiments? last one done with University of Jordan worked pretty well; logistical challenges.
2. Export control issues? The effort was arranged through the Department of State and IAEA so issues were addressed then.
3. Who does the teaching? Collaborative effort between staff and faculty.
4. How large is staff? 6 FTE, 10 student operators for a total of about 12 FTE.

UTILIZATION & RELEVANCE: MIT

Slide 1

1. Who fabricates the TRISO fuel? National Lab, INL as part of NGNP
2. Do you ever turn away customers? Yes, if funding they offer doesn't cover the engineering.
3. Suggestion was to develop a community-wide catalog of RTR capabilities.
4. How many students needed to make training program cost effective? For MIT, they can train up to 12. NCSU needs 8 to make it cost effective.

UTILIZATION & RELEVANCE: University of Missouri – Columbia



Slide 1

1. They have to generate about 90% of their budget.
2. How is working with NRC with proprietary information? Difficult, but they are pretty good to work with.

UTILIZATION AND RELEVANCY Challenges: Facilitated Discussion

1. Educational Utilization (coursed and laboratories)
    a. Connection with a department and faculty to actively bring in students and research work and funding
        i. NE Programs can typically utilize a series of labs and operations courses. Introductory chemistry classes can utilize half-life labs.
    b. Number of courses/students using the reactor
    c. Requires engaging students in meaningful laboratories embedded in curriculum, and not as an after thought
    d. UG and graduate research projects using the reactor.
    e. Hands-on lab courses using reactor or reactor facilities
    f. Distance education equipment and programs allow for offering educational services off campus and to other customers.
    g. Keep to your managements required metric, keep them informed of when you reach the goal
        i. There isn't always an established metric though.

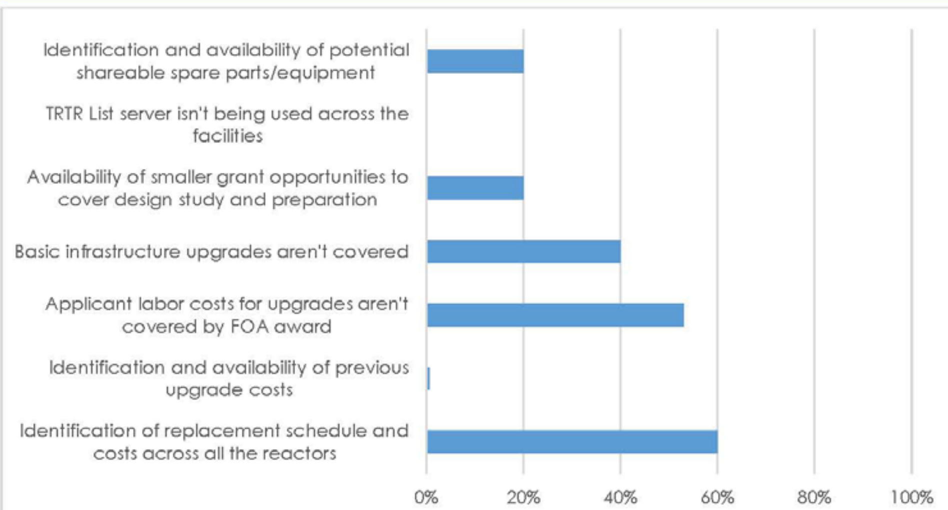
   h. 'Reactor operations course' focused on operational aspects as opposed to an engineering lab that covers material required for licensing
2. Nuclear engineering faculty are not necessarily the natural reactor users, while rector is naturally linked to nuclear engineering disciplinary.
3. Research Utilization (graduate and faculty)
   a. Connection with a department and faculty to actively bring in students and research work and funding
      i. With a smaller program or department, having more than one faculty member that does reactor-based research has been an historical challenge.
      ii. Administration must recognize and prioritize faculty who are targeted to perform research at RR. The community can build awesome facilities - but the user needs to be drawn in
      iii. Better integration of reactor staff with associated department (e.g., participating in faculty meetings) can support this a large degree.
   b. Requires assisting faculty with brainstorming research ideas and involving graduate students in research that will help develop new capabilities.
   c. Seed program offers cost-free access to reactor facility/staff if proposal is selected - encourages university faculty to develop research projects using reactor facilities with staff.
      i. This is critical. Utilization will increase with funding for proof-of-concept work or, more effectively, providing graduate student funding for projects utilizing the reactor.
4. Revitalization of programs after extended outage
   a. Little by little, after our 6-month outage in 2010 we reached out to former customers and did our best to show them that we could be depended on again. It's taken us almost 10 years to get back to where we were before that extended outage though.
   b. Provide learning opportunities that don't include the reactor.
      i. In our current reduction of operations, we have had to utilize isotope generators, sub-critical assemblies, and other facility equipment to maintain any draw.
5. Identification of customers before the rest of you guys swipe them up
   a. This is maybe a point where we need to work as a community to develop consortium and new capabilities. That way if a reactor is down, another can complete the work with each reactor serving their region.
      i. Perhaps NSUF could identify regional centers/hubs for specific types of research/utilization.
      ii. Facilities may be leery of sharing industrial customers with other facilities
      iii. Not all customers are legit, be wary and do your due diligence on them. There are a lot of fly-by-night outfits out there.
      iv. The idea would not be to reduce revenue of larger facilities by "stealing customers." Especially in the case where it isn't cost effective for a larger

facility to perform the work, it may be a plus for everyone if a small facility can cover.

6. Commercial Service Work
    a. Careful balance of revenue-making vs. prioritizing university's interests
        i. Is there a reasonable cost-benefit threshold that can be identified regarding extending operating hours to support both training and revenue-generating activities, or does it always end in the red?
    b. Commercial customers are often sensitive to turn-around time, so seeking customers with close proximity can be beneficial.
    c. Commercial clients often call asking for a lot of detailed information that requires time to put together, but don't follow through with use. So, this requires some weeding out of possible adventures and maybe upfront costs.
    d. Develop a screening program and charge the customer a fee for the screening and safety analysis.
7. Diversity of Customers
    a. Actively advertise and reach out to potential customers and users
        i. committing to one customer or one aspect of industrial activities can be dangerous for fiscal health of facility. diversity of customer base more of a requirement.
            1. This can be a challenge when a large potential opportunity arises, and university management only sees the potential income.
    b. If your facility can't support an education, research or commercial activity, please recommend another facility which can do the work.
    c. carefully describing specific strengths online can be helpful for attracting potential customers who are surveying the landscape.
    d. Develop detailed user guides, website with information, and easy methods for users to book facilities and arrange billing. Becoming a user facility for the University opens up research across the University or externally.
8. Developing New Research Capabilities
    a. Always be open to new challenges or research projects, don't immediately eliminate them just because your current TSs do not allow it.
    b. Be prepared to submit an LAR if needed
    c. Actively attempt to identify how the facility can be utilized by other faculty and researchers at the institution
        i. This is where the faculty connection to facility is critical. This is necessary for new research to be fostered
    d. Requires careful evaluation whether the revenue/research outcome is worth the upfront investment
    e. Finding physical space for new research activities
        i. Be proactive, if funding allows, to reconfigure labs, work areas, etc., for now research opportunities.
9. Novel Applications

   a. Novel applications should leverage host university research strength, e.g. engineering, chemistry, materials
10. Licensing/Regulatory Barriers to Work
   a. Analyze the work according to regulations and give that to the NRC for approval, don't depend on them to determine if it's ok.
   b. Engage the NRC as much as you can through any licensing action. I have found that the more you engage the more you will know what they need.
11. Meaningful metrics
   a. Number of publications using reactor
   b. Number of PhDs awarded using reactor
   c. Number of student operators
   d. Number of students doing research (regardless of publications or degree program)
   e. Number of projects and amount of support funding
   f. Service work funding
12. Juggling satisfaction of university's expectations and working on revenue-making activities
13. Infrastructure Changes Needed For New Utilization Activities; Waste Generation From New Utilization Opportunities
14. advocate support for TRTR community/highlight RTR accomplishments.

VOTING ACTIVITY: Infrastructure – Top 2 Challenges



Infrastructure Solutions

1. Identification of replacement schedule and costs across all the reactors

VOTING ACTIVITY: Infrastructure – Top 2 Challenges

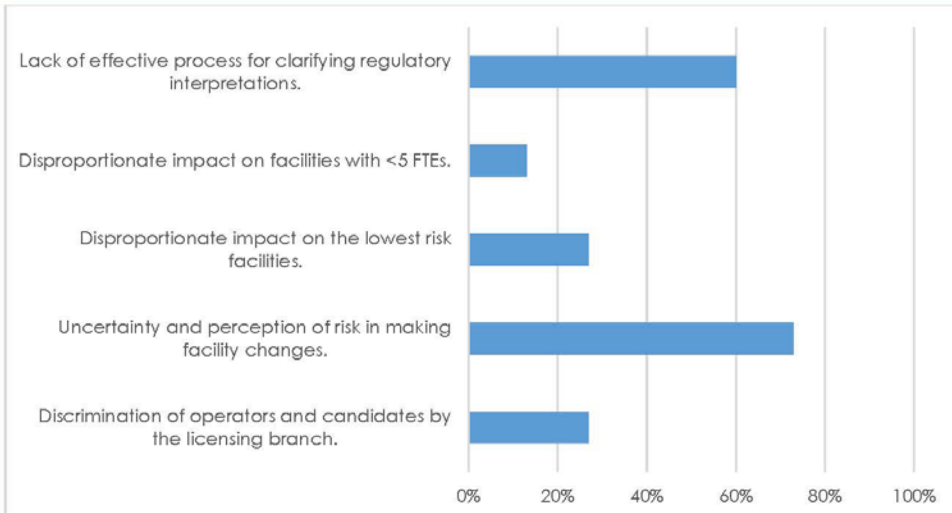
a. Needs to be standardized way to report these... Are we adding more burden?!
    i. This seems like a significant burden for someone if they're doing it on their own time with no compensation.
b. Need a DOE sponsored audit program with a group of external auditors who could visit each facility and forecast infrastructure needs using a consistent process. Do not use the list as a criterion for evaluating NEUP proposals, but only as a tool to forecast program needs.
    i. Upvote.
    ii. If the data was anonymized when provided to DOE, it may provide some assurance against "misuse."
        1. That is, TRTR can maintain full dataset, DOE has anonymized data.
    iii. IAEA does something similar to this, called OMARR
    iv. I don't necessarily think an auditor from DOE should be going around to each facility. I think we can self-police. In the end, the proposal review process will do this regardless.
c. This should generate a report to submit to the DOE asking for more funding to fully cover these costs.
d. Method for evaluation should follow industry standards, ATR methodology.
    i. Can ATR provide methodology on either of the TRTR listservs?
        1. Sean said he would present at TRTR how they did it with a spreadsheet/template to start.
e. Solution ideas captured during working group session: Conduct a "Plant Lifetime Extension Study" that would produce a priority list report that is updated every 5 years
    i. Sean suggested that maybe TRTR or Professional Development funding could be used to pay for travel for experts to go to universities to assess conditions by primary component; Light Water Reactor Sustainability program is also a possibility; need realistic costs; methodology and template could be sent to universities to self-asses prior to the need for an expert review

2. Identification and availability of previous upgrade costs
    a. Utilize upgrade project designs and costs for projects completed at other facilities as basis for design and budget scoping for upgrade proposals.
    b. Perhaps a more succinct overview of prior year awards, dollar amounts, and purpose?
        i. This would be helpful for those applying for grants to contact the facility to find out vendors and what they did.
    c. Make public a final report from the infrastructure upgrade that details vendor, lessons learned, challenges, etc.
        i. ...and design strategy (if not confidential) ... i.e. were digital components considered (why/why not), other beneficial design aspects
3. Availability of smaller grant opportunities to cover design study and preparation
    a. "Update the CSIS FOA to reflect current University Research Reactor needs."

VOTING ACTIVITY: Infrastructure – Top 2 Challenges

b. Basic infrastructure upgrades aren't covered
c. Applicant labor costs for upgrades aren't covered by FOA award

VOTING ACTIVITY: Licensing & Regulatory – Top 2 Challenges



Licensing & Regulatory Solutions

1. Uncertainty and perception of risk in making facility changes.
    a. More community coordination on 50.59 screens and evaluations. Some facilities can provide insight and experience in "peer reviewing" evaluations.
        i. I think anyone in the TRTR community would be willing to do this if you email your 50.59 review and change proposal to them.
    b. Benchmark a few 50.59 evaluations for changes with different levels of risk and different answers across as many RTRs as will participate
        i. This may be helpful to facilities that lack the experience in performing the screenings.
        ii. The sharing of successful 50.59 screenings and evaluations for different levels of upgrades could be helpful to see what the NRC has already found acceptable.
        iii. Create a numeric rubric/metric to help RTRs with 50.59 screening based on history of 50.59 reviews and any NRC feedback we have across the community
    c. TRTR effort to send a letter to the NRC with examples of how we have been impacted by the regulator's subjective interpretation of regulations as they have applied them during the LAR process or during inspections of our own 50.59 screenings.

VOTING ACTIVITY: Licensing & Regulatory – Top 2 Challenges

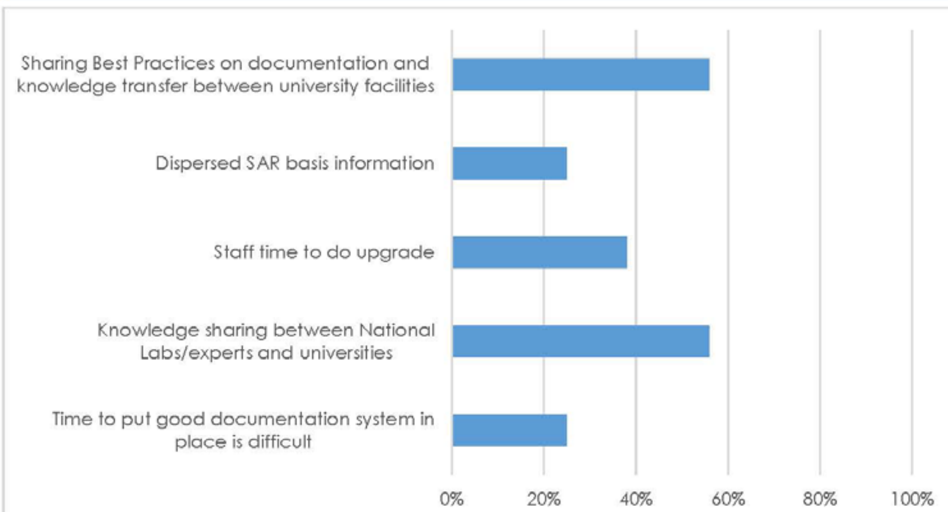
d. Consolidate all of the 50.59 violations that have occurred at RTR facilities and see if there has been a common theme/root cause.
    i. This would be helpful for facilities to read through or database to check for any licensing or 50.59.
e. As community, we should look at TS and SAR to find discrepancies from facilities, maybe standardizing some of these.
f. Consolidate all 50.59 screenings TRTR wide to understand collective screening threshold
g. Share your successful LAR with dockets numbers for others to use a basis for their LAR's.
h. Have standardized examples of 50.59 evaluations for various systems that all TRTRs have: rod control, protection system, indication, etc.
i. Big thing that I wish I would have brought up earlier was a checklist by the NRC for the LAR process that is externally published...
    Phase 0
    Application Submitted
    Application Acceptance Review
    Initiation of Application Review
    RAI's sent
    SER sent to the OGC
    Environmental Impact
    Approval
    i. With **expected** timeline for each step

2. Lack of effective process for clarifying regulatory interpretations.
    a. Share past NRC decisions on interpretation to establish precedent.
    b. Increased interaction between the NRC and TRTR community. The ANS standards committees can only do so much, most disconnects affects nearly every facility.
        i. NRC is currently pushing less interaction. As an example, travel budgets to TRTR on the part of the NRC have been slashed.
        ii. ANS Standards Committee does not have a good record of timely revisions (e.g., 'certified operators')
        iii. NRC and TRTR have quarterly contact to discuss issues
    c. Have the TRTR community submit written interpretation requests to the NRC and have them docketed. That way, the NRC must review and respond.
        i. The TRTR Exec Committee should have more interaction with regulator in the formal space to request interpretation
    d. TRTR effort to send a letter to the NRC with examples of how we have been impacted by the regulator's subjective interpretation of regulations and the delay on clarification.
        i. It is always a problem to identify cases of specific examples, as those licensees will continue to be regulated by the NRC.

VOTING ACTIVITY: Licensing & Regulatory – Top 2 Challenges

e. A dedicated "program manager" staff member at the NRC to track, review, and report on these issues
f. Mandate a turnaround time for questions on regulation interpretations
g. Suggest DOE-NEUP support generic analysis for MTR and TRIGA type reactors which can provide high-level guidelines for setting facility safety limits.
    i. The reactor analyses group at INL would like to do this work for the community, they could also help build more detailed models for facilities and simulations for facilities.
    ii. This could particularly help lower-power facilities, which are probably enveloped by analysis done to higher-power facilities.
    iii. This has been discussed in some form (generic analysis) by NRC and TRTR for years
h. How about TRTR create a consistent message on an issue that tell the NRC TRTR's stance or interpretation on the docket. We should not be letting NRC take the lead, we should!
    i. Upvote
    ii. Strong agree!

VOTING ACTIVITY: Staffing & Knowledge – Top 2 Challenges



Staffing & Knowledge Transfer Solutions

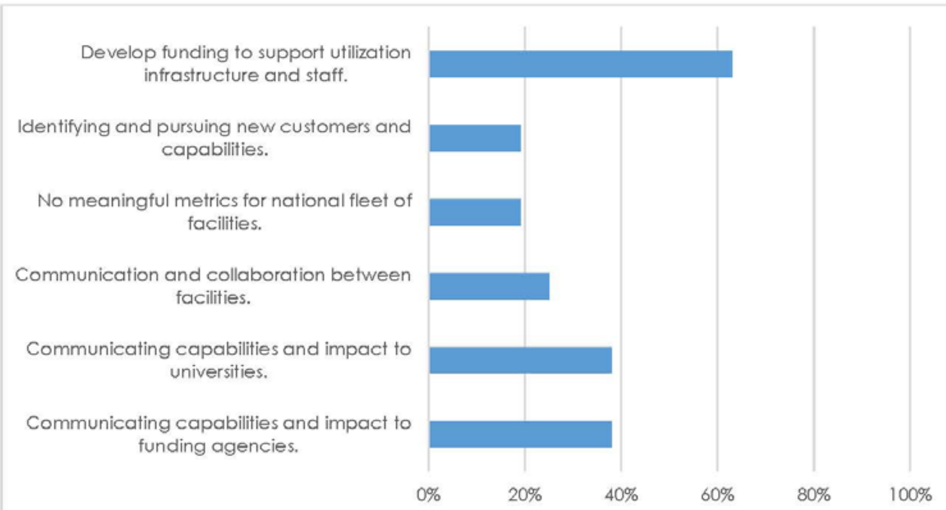
1. Sharing Best Practices on documentation and knowledge transfer between university facilities
    a. Funding for TRTR peer reviews

VOTING ACTIVITY: Staffing & Knowledge – Top 2 Challenges

        i. Up vote, it would be very helpful for facilities to see other facilities and share experience.
        ii. Standardized 'broad scope' peer review procedure/process that captures community best-practice knowledge base so that reviewers can make recommendations/provide advice, and not just review against licensing requirements.
    b. Form a TRTR-sanctioned committee to develop a best practice document to be presented at a national TRTR meeting and stored on the website, including a list of criteria for peer reviews.
        i. Super upvote.
        ii. The website would be an excellent location to collect and distribute this information.
        iii. Excellent idea!
        iv. Strong agree on this -
        v. Website going to get a little "functionality" revamp in the coming months... stay tuned! -CHT
        vi. Criteria for peer reviews should be broad based and include (at a minimum): 1) compliance with license conditions; 2) utilization assessment against national metrics; 3) adequate documentation/planning for knowledge transfer;
    c. Potential for DOE to Fund Grad students focused on retaining institutional / facility knowledge
    d. Suggest TRTR forms a working group with DOE-NE funding. Documentation and best practices preserve the expertise exist in the RTR community and would benefit future new RTR, such as VTR.
    e. Method to verify T&R status for other facilities to have more liberal sharing of information
        i. Upvote
        ii. **other facility personnel
    f. Maybe the newsletter could have an "Ask a Manager" section as a way to share best practices?
2. Knowledge sharing between National Labs/experts and universities
    a. Access to INPO database
    b. Funding within DOE to support different DOE groups outreach to university reactors.
    c. Small DOE budget to support these requests on an as-needed basis
    d. DOE program for proposing funding to provide national lab subject matter and analysis support.
        i. Possibly include graduate student funding for analysis work with support from national lab expert.
        ii. Agree with comment above - GS Natl lab collaboration would be beneficial to both facilities and students

   e. suggest DOE-NE fund research to study generic safety analysis for TRIGA and MTR fueled reactors. Research should be published in peer-reviewed journal which would be beneficial to both NRC and facilities. (Lin-wen)
      i. Strongly agree
   f. Create a POC list at National Labs that would support the TRTR needs.

VOTING ACTIVITY: Utilization & Relevancy – Top 2 Challenges



Utilization & Relevancy Solutions

1. Develop funding to support utilization infrastructure and staff.
   a. New category of DOE funding for activities/upgrades that improve research capabilities and make the facility more relevant.
      i. Make funding specifically available to reactors.
      ii. The addition of graduate student funding from DOE to support the reactor community explicitly would be a great thing
   b. Develop a white paper/report that highlights the capabilities and accomplishments of each facility.
      i. Who is the target audience for the white paper?
   c. Examples from facilities of how they communicate with their administration would be helpful
   d. Create a [Funding agency] fellowship that supports 2 graduate student involvement directly with each reactor... Could be operations, Ugrad staff training, licensing, etc. This will create Human Capital that will be strong applicants for Advanced Reactors in the particular companies, the regulator, etc.

        i. Strong agree with this concept
        ii. That would be 50 fellow today
    e. Increase the number of facilities that are NSUF facilities.
        i. What would we need to bring all of TRTR into NSUF if each facility is interested?
            1. Is it feasible?
    f. Outreach funding like the old Reactor Sharing Program could tie into this. Funding for a percentage of an FTE could help increase staffing and increase utilization.

2. Communicating capabilities and impact to stakeholders.
    a. Provide "success stories" to DOE-NE, based on funding from DOE.
        i. This would involve small effort for potentially good returns.
        ii. strongly support
    b. TRTR Position papers (like ANS position statements)
    c. Develop uniform URR community-wide metrics to communicate value to stakeholders. Value statements incorporate 1) aspects of university mission (education, training, service), and 2) national mission - DOE/NSF mission goals
        i. University administrators may not understand the national value of their URR facility. Uniform metrics quantifying how their URR contributes to/supports both the university and national mission allows them to make a case for supporting the facility and having a sense of its growth potential if provided adequate resources
        ii. oops - forgot to add RESEARCH to university mission value statement
    d. Develop national TRTR whitepaper, updated annually, that shows the national importance of research and test reactors.
    e. The number of people who tour university RTR is probably ~30,000/year. More people are exposed to nuclear technology via these facilities than anything other than nuclear medicine.
        i. RTR tours are a great way to communicate with other campus members - students and administration both the value of the facility to the campus community
    f. Organize a workshop/symposium to showcase utilization/accomplishments of RTR and produce a topical report available to stakeholder.
    g. Work together to generate press releases, social media, and communications both at the university and national level of work completed, novel approaches, or areas of research.
    h. TRTR/NSUF websites highlight utilization accomplishments of RTRs.
    i. Describe impact on human capacity building and make the importance known to DOE, NRC, and other decision makers. Make the case that research reactors are critical as part of nuclear engineering education.

VOTING ACTIVITY: Utilization & Relevancy – Top 2 Challenges

Page intentionally left blank

Appendix C

Presentations from TRTR Panel Session (September 2019)

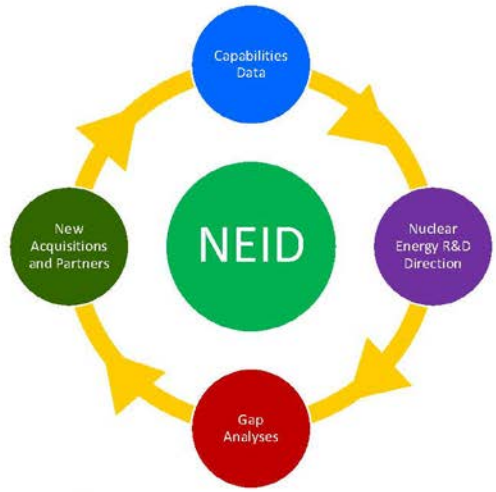
Page intentionally left blank

Appendix C

Presentations from TRTR Panel Session (September 2019)

Background

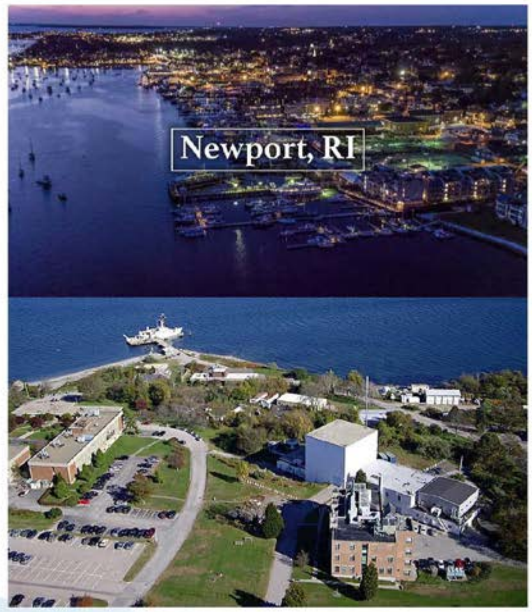
- Nuclear Science User Facilities (NSUF) has an infrastructure management program to support the DOE-Office of Nuclear Energy priorities.
- NSUF administers the University Infrastructure FOA, which includes the Reactor Upgrades work-scope.
- This review started in FY2017 as an effort to look at US URR infrastructure, particularly control consoles, and establish a list of needs and priorities and a schedule for implementation.



NSUF

Background

- Kickoff at the 2018 TRTR meeting.
- Clive Townsend (Purdue) volunteered to work with NSUF and wrote the initial problem statement document.
- NSUF secured funding for the effort after consultation with DOE-NE.
- Expanded the mission from just infrastructure to cover any issue that could affect the continued operation of the Nation's university research reactor fleet.



NSUF

URR Fitness Study Flow

1. Web Survey of US University Reactor Facilities
   - 23/25 facilities participated in the survey
2. Facility Presentations & Discussion
   - 60 minutes
3. Facilitated Discussion with ThinkTank™
   - 30 minutes
4. Working Groups
   - Elect a chairperson
   - Discuss the issues and the big challenges
   - Prioritize the issues and work on solution pathways
   - Develop a path forward with recommendations
5. TRTR Annual Meeting
   - September 22-26 (Idaho Falls)
   - Panel Session to present to the whole community
6. Formal Report to DOE-NE
   - December 2019

Survey Results - Infrastructure

Four areas of inquiry

1. Control Consoles
2. Major Infrastructure
3. Safety Equipment
4. Maintenance

Overarching Issues

1. Equipment Aging
2. Equipment Obsolescence
   - manufacturer goes out of business
3. Civil Engineering (building) issues
4. Digital Console Conversion
5. Critical Spare Parts

NSUF

Survey Results - Regulation

Three areas of inquiry

1. Changes in Regulation
2. Facility Change Control
3. Licensing and FSAR

Overarching Issues

1. Burden is a drain on facility resources
2. Reluctance to upgrade equipment
3. NRC use of (NPP) contractors for licensing reviews
4. Lack of internal SME for analysis to support LAR/SAR work (contractor vs. training)
5. Utility of 10CFR50.59 process for changes
6. Disproportionate Impact on smaller facilities

NSUF

Survey Results – Staffing and Knowledge Transfer

Four areas of inquiry

1. Staffing Changes
2. Staffing Requirements
3. Knowledge Transfer
4. Fuel Shipments

Overarching Issues

1. Recruiting and keeping permanent staff
2. Utilization of students (operators + ???)
3. Succession and Knowledge Retention planning
4. SME staff vs. Flexibility
5. Access to external SME resources
6. Standardized safety analyses, etc.
7. Ease of fuel shipment/receipt

NSUF

Survey Results – Utilization and Relevancy

Overarching Issues

1. Educational Utilization (courses and laboratories)
2. Research Utilization (graduate and faculty)
3. Commercial Service Work
4. Diversity of Customers
5. Novel Applications
6. Licensing/Regulatory Barriers to Work

NSUF

Fitness Area Working Groups

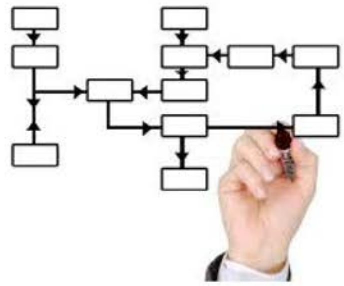
- Infrastructure – Matt Lund (Utah)
- Regulation – Bruce Meffert (MURR)
- Staffing – Jeff Geuther (Penn State)
- Utilization – Clive Townsend (Purdue)

TRTR Panel Discussion

1. Problem Statement for each area
2. Discussion items from workshop
3. Challenge 1 → Proposed Solution 1
4. Challenge 2 → Proposed Solution 2
5. Path forward

Path Forward Following TRTR 2019

1. NSUF Report to DOE-NE-5 (12/21/2019)
2. Input into NSUF Capabilities Gap Analysis Report (6/30/2020)
3. Input into FY2020 Consolidated Scientific Infrastructure Support FOA (6/30/2020)



4. TRTR actions …

NSUF

INL/CON-19-55556

Contact Information

Brenden Heidrich
(208) 526-8117
Brenden.Heidrich@INL.gov



NSUF@INL.gov
NSUF.INL.gov

Nuclear Engineering
THE UNIVERSITY OF UTAH

UNIVERSITY RESEARCH REACTOR FITNES WORKSHOP - INFRASTRUCTURE CHALLENGES

IDENTIFIED CHALLENGES

- Equipment Aging/Obsolescence
- Civil Engineering (building issues)
- Digital Console Conversion
- Critical Spare Parts
- Equipment Lifetime Shorter with Longer Lead Times for New Equipment
- Only 1 No Cost Extension on DOE Grants
- No Off-the-Shelf Parts
- Disappearing Vendors
- Licensing Uncertainty
- Lack of Expertise
- Not Using Lessons Learned from Other Facilities

HIGHEST PRIORITY CHALLENGES

1. Identification of replacement schedule and costs across all the reactors.
2. Applicant labor costs for upgrades and basic infrastructure upgrades aren't covered by FOA award.

Nuclear Engineering
THE UNIVERSITY OF UTAH

CHALLENGE #1 – PROPOSED SOLUTION

1. Identify replacement schedule and costs across all the reactors.
   a. Standardized form of reporting maintained by TRTR with DOE anonymized data.
   b. Method for evaluation should follow industry standards, for example ATR methodology with a template.
   c. DOE sponsored audit program with a group of external auditors (DOE or TRTR), visiting each facility.
   d. Submit a report to DOE asking to fully fund costs.
2. Identify previous upgrade costs and make available to community.
   a. Utilize upgrade project designs and costs completed at other facilities as basis for design and budget basis.
   b. More detailed overview of prior year awards, dollar amounts, and final report from the infrastructure grant that details vendors.
   c. Create database of vendors, components used in research reactors, lessons learned, challenges, design strategy, etc…

CHALLENGE #2 – PROPOSED SOLUTION

1. Make available smaller grant opportunities to cover design study and preparation.
2. Update the FOA to reflect current University Research Reactor needs.
    a. Include basic infrastructure upgrades.
    b. Include applicant labor costs for upgrades.

PATH FORWARD

1. Secure DOE funding and support to create a database of replacement schedules.
2. Create a database of costs using a standardized format.
3. Submit a report to DOE outlining long term funding needs per year with request to support building infrastructure and internal labor costs.
4. Create database of vendors, components, and lessons learned.

OPEN DISCUSSION/QUESTIONS

University Research Reactor Fitness Workshop – Licensing and Regulation

Bruce Meffert, Working Group Lead

TRTR Annual Meeting
September 22-26, 2019
Idaho National Laboratory, Idaho Falls, ID

MURR®
Providing quality nuclear research, education and service to a global community

Introduction of Licensing and Regulation

July 2019 Process:

1. Brainstorming in small group. List of all ideas kept. Small group tried to boil ideas into a few challenge statements.
2. List of ideas and challenges presented to all workshop participants. Facilitated discussion made about five (5) challenge statements.
3. Computer voting occurred to reduce the five (5) challenges down to two (2) challenges
4. Workshop participants then added potential solutions for the two (2) challenge statements.

MURR®

Providing quality nuclear research, education and service to a global community

Introduction of Licensing and Regulation

Facilitated discussion:

- How regulatory burden is a drain on RTR resources
- How this burden affects small facilities
- Timely resolution of regulatory inconsistencies: Initial startup, etc.
- Uncertainty in interpretations: 50.59 or be safe with 50.90
- Reluctance to make major upgrades to equipment (lack of SMEs for analysis, lack of LAR preparation time, and uncertainty)
- Inconsistency in licensing operators
- Communication with NRC

3

MURR®

Providing quality nuclear research, education and service to a global community

Agreed-Upon Challenges

- Lack of effective process for clarifying regulatory interpretations

- Uncertainty and perception of risk in making facility changes

4

MURR®

Providing quality nuclear research, education and service to a global community

Proposed Solutions

Lack of effective process for clarifying regulatory interpretations

- Share past NRC decisions on interpretation to establish precedent.

- Increased interaction between the NRC and TRTR community. The ANS standards committees can only do so much, most disconnects affects nearly every facility.

- Have the TRTR community submit written interpretation requests to the NRC and have them docketed.

- TRTR effort to send a letter to the NRC with examples of how we have been impacted by the regulator's subjective interpretation of regulations and the delay on clarification.

5

MURR®
Providing quality nuclear research, education and service to a global community

Proposed Solutions

Lack of effective process for clarifying regulatory interpretations (continued)

- Have a dedicated "program manager" staff member at the NRC to track, review, and report on these issues.

- Mandate a turnaround time for questions on regulation interpretations.

- Suggest DOE-NEUP support generic analysis for MTR and TRIGA-type reactors which can provide high-level guidelines for setting facility safety limits.

- TRTR should create a consistent message on an issue and then tell NRC our stance or interpretation on a docketed document. We should take the lead.

MURR®

Providing quality nuclear research, education and service to a global community

Proposed Solutions

Uncertainty and perception of risk in making facility changes.

- More community coordination on 50.59 screens and evaluations. Some facilities can provide insight and experience in "peer reviewing" evaluations.

- Benchmark a few 50.59 evaluations for changes with different levels of risk and different answers across as many RTRs as will participate.

- TRTR effort to send a letter to the NRC with examples of how we have been impacted by the regulator's subjective interpretation of regulations as they have applied them during the LAR process or during inspections of our own 50.59 screenings.

- Consolidate all of the 50.59 violations that have occurred at RTR facilities and see if there has been a common theme/root cause.

- As a community, we should look at TS and SAR to find discrepancies from facilities, maybe standardizing some of these.

7

MURR®

Providing quality nuclear research, education and service to a global community

Proposed Solutions

Uncertainty and perception of risk in making facility changes. (continued)

- Consolidate all 50.59 screenings TRTR wide to understand collective screening threshold.

- Share your successful LAR with dockets numbers for others to use a basis for their LAR's.

- Have standardized examples of 50.59 evaluations for various systems that all TRTRs have: rod control, protection system, indication, etc.

- A checklist by the NRC for the LAR process with an expected timeline that is externally published...
  - Phase 0
  - Application Submitted
  - Application Acceptance Review
  - Initiation of Application Review
  - RAI's sent
  - SER sent to the OGC
  - Environmental Impact
  - Approval

MURR®
Providing quality nuclear research, education and service to a global community

8

Path Forward

1. Proposed solutions need to be consolidated
2. Community champions assigned to each solution
3. Deadlines agreed upon for milestones
4. Formal report to DPE-NE
5. Quarterly communication to the community on the progress on each solution

Open Discussion/Questions

10

MURR®

Providing quality nuclear research, education and service to a global community

University Research Reactor Fitness Workshop – Staffing and Knowledge Retention

Jeffrey Geuther, Working Group Lead

TRTR Annual Meeting
September 22 – 26, 2019
Idaho Falls, ID

PennState
College of Engineering

Radiation Science & Engineering Center


Staffing and Knowledge Transfer
• TRTR community features facilities that very greatly in size, staffing, and resources. However,
• All facilities must maintain the ability to operate in a manner that ensures minimal risk to the public.
• All facilities must maintain requalification program and well-written procedures and SAR analysis capability.
• All facilities must be able to support license amendments / renewals.
Radiation Science & Engineering Center
PennState College of Engineering

Identifying Challenges – Brainstorming Discussion Items

- Retaining staff
- Utilizing student operators
- Recording / preserving requalification seminars
- Utilizing outside expertise
- Document organization, scattered SAR basis information
- Sufficient staffing for license actions / major upgrades
- Maintaining support for tours without reactor sharing funding

Radiation Science & Engineering Center

PennState
College of Engineering

Highest Priority Challenges

Challenge #1

Sharing best practices on documentation and knowledge transfer between university facilities

Challenge #2

Increasing knowledge sharing between national labs and universities

Radiation Science & Engineering Center

PennState College of Engineering

Challenge #1 – Proposed Solutions

Sharing best practices on documentation and knowledge transfer between university facilities

- Funding for TRTR peer reviews
- Form a TRTR-sanctioned committee to develop best practice document for conducting peer reviews
- Potential for DOE to fund graduate students focused on retaining institutional knowledge
- Form TRTR working group with DOE funding to focus on documentation and preserving best practices
- Add a section to the TRTR newsletter to share best practices
- Method to verify T&R of other facilities personnel to facilitate sharing of information

Radiation Science & Engineering Center

PennState
College of Engineering

Challenge #2 – Proposed Solutions

Increasing knowledge sharing between national labs and universities

- Access to INPO database
- Funding within DOE to support DOE outreach to University reactors
- Small DOE budget to support TRTR needs on an as-needed basis
- DOE generic safety analysis for common reactor types, document in peer-reviewed publication
- DOE program for proposals to request funding for national lab subject matter / analysis support
- Create POC list at national labs that would support TRTR needs

Radiation Science & Engineering Center

PennState
College of Engineering

Challenge #1 – Path Forward

Sharing best practices on documentation and knowledge transfer between university facilities

Funding for TRTR peer reviews, consider a standardized process that would be used throughout the community

Develop a best practice document, developed by a TRTR committee, that could form as a basis for peer reviews. This document could be accessed on the TRTR website.

Radiation Science & Engineering Center

PennState College of Engineering

Challenge #2 – Path Forward

Increasing knowledge sharing between national labs and universities.

Identify DOE funding to provide national lab expertise and support for analysis at university reactors.

Create a point of contact list at national labs that would support TRTR needs.

Leverage lab expertise to produce generic safety analyses for common RTR designs (i.e., TRIGAs and MTRs).

Radiation Science & Engineering Center

PennState College of Engineering


Open Discussion / Questions
Radiation Science & Engineering Center
PennState
College of Engineering

UNIVERSITY RESEARCH REACTOR FITNESS WORKSHOP

Utilization & Relevancy

CLIVE TOWNSEND, WORKING GROUP LEAD
SEPTEMBER 2019

PURDUE UNIVERSITY

Identified Challenges

Wide capabilities lead to broad challenge set

- Educational Utilization
- Faculty not necessarily connected with reactor capabilities
- Revitalization of facility after extended outage
- Identification of customers before being grabbed by other reactors
- Commercial service work
- Diversity of customers
- Developing new capabilities
- Novel applications
- Licensing/Regulatory barriers to potential work
- Lack of meaningful utilization metrics
- Juggling university expectations and realistic timelines

PURDUE UNIVERSITY

Highest Priority Challenges

Expand, support, and communicate

- Develop funding to support utilization infrastructure and staff
- Communicating capabilities and impact to universities
- Communicating capabilities and impact to funding agencies

PURDUE UNIVERSITY

Challenge #1: Proposed Solutions

Develop funding to support utilization infrastructure and staff

- Recommend additional separate funding category specifically geared to expanding utilization
- Leverage human capital development initiatives at various funding agencies to support a graduate fellowship(s) at each facility
- Outreach funding analogous to Reactor Sharing Program could be considered. Funding for a percentage of an FTE would help increase staffing and increase utilization.

PURDUE UNIVERSITY

Challenge #2: Proposed Solution

Communicating capabilities and impact

- Provide success stories report of funding impact to facilities on public impact, research, and education
- Deliver report annually describing the way TRTRs deliver on the critical national infrastructure mission
- Consider developing uniform TRTR community-wide metrics to communicate value to stakeholders.
- Would include aspects such as community engagement, research usage, teaching accomplishments, and ... ?

PURDUE UNIVERSITY

OPEN DISCUSSION AND QUESTIONS?

Utilization & Relevance

CLIVE TOWNSEND, WORKING GROUP LEAD
SEPTEMBER 2019

PURDUE UNIVERSITY

THANK YOU

Discussion and community feedback on posture review meeting.

WE ARE PURDUE. WHAT WE MAKE MOVES THE WORLD FORWARD.

PURDUE UNIVERSITY

EA/EOU