FY 2023 Consolidated Innovative Nuclear Research (CINR) Topic Area Question and Answer (Q&A)

CINR Overview Q&A

Q: Will there be restrictions for non-US citizens?

A: No. The US Institute of Higher Education, National Laboratories, and Industry can apply to the funding opportunity. There's no restriction on, for example, a lead PI if they have faculty status at that US institution.

Q: Did I hear correctly that there will be no relevancy review?

A: No, there will be relevancy review, but it is intended to have less of a program specific, or program priority focus, and have more of a mission focus. Every application is still going to be evaluated for relevance to Office of Nuclear Energy mission before it's passed forward to full technical review.

Q: Is it intentional that technical points of contact are not specified in the draft call?

A: It is intentional, applicants should engage with Federal points of contact. As the mission areas and the topical areas have expanded to be much broader, there may be multiple technical points of contact at the national laboratories for each topic area. It isn't a requirement to align with the NE programs to apply to the funding opportunity. The Federal points of contact are the designated contacts to be able to answer any mission focused questions, which is why they are listed in the funding opportunity and the draft scopes.

Q: For the current and pending support document, will NEUP still accept the NSF format or the SciENcv template?

A: Yes, the current and pending support template that we're moving to is the OMB approved NSF format.

Q: How many applications can a single PI submit?

A: For a single PI, it depends on what applications you're trying to submit. But in general, a lead PI can submit six total applications, three in a lead role and up to three not in a lead role. It's flexible, but if you your name is on more than six applications, that would exceed the limit. You can do six collaborations, for example, if you didn't want to be a lead PI.

Q: Is the restriction for three active NEUP R&D projects as a lead PI?

A: That is correct. It does not include NSUF Access Only projects, infrastructure projects, or Distinguished Early Career Program projects. Three active projects refer to NEUP R&D projects.

Q: Does the Distinguished Early Career Program count towards the maximum number of awards?

A: No.

Q: Another eligibility question regarding eligibility policy for PIs. Is a staff scientist at a university considered as faculty? There doesn't seem to have been an issue regarding this in previous CINR funding opportunities, but I'd like to make sure.

A: Your specific university is going to define who can act as a lead principal investigator. If you're on a joint appointment or adjunct faculty position actively working in industry or the national laboratory, we wouldn't consider that appointment to be a university employee. But your university is going to define a staff scientist or postdoc or tenure track or research scientist to be the lead PI depending on the specific university policy which may vary.

For universities, research scientists or anybody, you don't have to have faculty status per se. You just have to be approved by your university to submit the proposal to an outside agency and be the PI so that's the criteria set by your own university. If you're familiar with CINR FOA, in past years, there's a lot of information under the eligibility section. Take the time necessary to read through that section once you see the FOA has come out, once it's posted and make sure that you understand and know what those guidelines are. If you have questions at that point in time, please reach out and ask about any clarifications that are needed. We will be happy to follow up with you and make sure that you understand the requirements thoroughly.

Q: Could you please explain a little bit more about the planned office hours?

A: The idea behind the office hours is to set up a set of Teams meetings with federal program managers, some points of contact, including national technical directors from the programs and others to be able to have a back-and-forth conversation about specific topical areas, specific programmatic work, or programmatic topics that university professors are interested in. This webinar format tends to be relatively limited with written questions, which results in an output of information. The office hours is intended to be an additional opportunity to help clarify where the NE mission space is and what the programs are currently doing to try to provide more engagement with federal program managers and national technical directors in an appropriate space for a funding opportunity where we don't run the risk of violating the parameters of procurement standards.

Q: Will the relevancy be reviewed for both pre-application and full application and how much weight would it carry?

A: Relevancy will be reviewed for both pre-application and full application. The review will be focused on whether it is relevant and will not carry a weight. The new review paradigm will be placing more weight on the scientific and technical merit review, rather than how relevant it is to NE mission or to the programs.

Q: Along those lines, who would be conducting the relevancy review? Would that be external reviewers, or by NE?

A: Relevancy reviewers are going to be determined by DOE and will have a strong knowledge of the NE mission.

A: How are the proposers expected to address relevance of ideas without insider knowledge of the Office of Nuclear Energy?

A: We are planning those opportunities with the office hours event to make sure that you can ask those important questions directly to the program manager or others. Relevancy will be judged by whether the application falls within the NE mission space. That mission space is intentionally broad to allow flexibility in what you propose, as university professors, and feel might be creative solutions to those problems. It de-emphasizes program relevance/priority and focuses on scientific and technical merit. If you look up the Office of Nuclear Energy at DOE for its mission, it's broad. Anything that fits under that mission statement is going to be relevant to one of the topic areas.

Q: Can a PI change his institution affiliation in the full application if he or she transferred after submitting the pre-application with another institution?

A: No. The PI change policy would take effect after the pre application is submitted. Please refer to the PI policy change move guidance that's on the NEUP.gov website and contact us as soon as possible if this is a possibility for you.

Q: Are considerations for Minority Serving Institutions new to CINR or how has it changed since last year, if at all?

A: We've considered this type of scoring criteria since the 2014-2015 timeframe. It changed to focus on Minority Serving Institutions several years ago but has been consistent since that time.

Q: Could you please explain the eligibility regarding NSUF, specifically, how you would understand all projects proposed must have established R&D funding from another source.

A: From a NSUF access standpoint, there are readiness requirements for the samples. From a readiness standpoint, there are requirements about materials being available and need be ready to irradiate. An awarded NEUP project that has samples that are in a ready state according to the NSUF guidelines could apply for "NSUF Access Only" to irradiate those samples in a reactor, for example at ART or MIT etc. The point being that there isn't directly tied research and development funding and access that are combined. That's been an aspect of the CINR FOA for quite a few years.

Q: For the other subtopics in each topic area, where can we find more information regarding the technical need or technical requirement of these other subtopics?

A: As you hear the presentations over the next two days, it will provide you with the full space for that topic area. When you think about any of the given topic areas, the program overviews that were given today talked about the different program activities that are happening, and those, along with presentations from this webinar, will inform you of the mission space where there are other categories that aren't necessarily described in detail in the sub topical areas. It's up to the applicant to define and make the case that what they're submitting is very important to the success of nuclear energy in this country in those open areas. It allows for maximum innovation on your part. We're looking for new ideas too, it's not just responding to a particular need. The nuclear energy mission is wide open, so you tell us what's important, what's going to succeed and what's going to work and that's what we're interested in.

Q: I am currently a PI on a reactor upgrade-funded project that ended this October. Am I eligible to apply for this year's call?

A: Infrastructure projects are not considered when DOE evaluates eligibility for individual PIs.

Q: Is there an engagement opportunity with federal program managers or technical points of contact?

A: Yes, DOE has planned an 'Office Hours' opportunity to have an open format engagement with program managers and technical points of contact.

Q: What if proposers cannot reach during office hours due to other scheduling conflicts due to the last-minute nature of the dates for the webinar?

A: Applicants can submit questions before the Office Hours event, and all interactions will be recorded and posted out on NEUP.gov. Outside of the Office Hours opportunity, applicants can use conventional means to interact with program managers working through the NEUP Integration Office.

Q: Is the no-cost time extension automatically allowed for the project due to COVID delay? How will this affect the eligibility of a NCE beyond Dec. 31, 2023, because of COVID delay?

A: NCEs are not automatically granted for Covid extensions. Due to the COVID-19 pandemic, FY 2017-2019 active projects will not be counted toward eligibility restrictions.

Q: Is there a funding vehicle for intangible, services-based projects which expand capabilities of the university reactors as a community?

A: No, there isn't a funding vehicle for intangible, services-based projects.

Currently, the purposes of the infrastructure program include:

1. Upgrade and improve U.S. university nuclear research and training reactors: Applications should be directed to the upgrade of the research reactor or to the purchase/maintenance of equipment and instrumentation for activities related to the safety, performance, control, or operational reliability of the research reactor, including security/safety enhancements required by the federal/state/local regulatory agencies; or
2. 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; and
3. Contribute to strengthening the academic community's nuclear engineering infrastructure.

Q: We understood that that this program does not provide funding for international collaborators. In the past, UK government has provided a matching fund to NEUP programs in some areas. Will that participation be part of the FY 2023 CINR FOA?

A: The UK's ESPRC will not be participating in the FY 2023 CINR FOA. International collaborations are still encouraged but no federal funds can be sent to international institutions.

Q: Can NEUP awards be used to support oversea travels like visiting an international research facility to perform site-specific experiments or attending international conferences? If we have an exchange student visiting us from an international collaborator, can we use this award to pay their stipends?

A: If international travel is outlined in the application, it can be approved for those working on the project. Funds can only be used for those working at U.S. institutions. If a student is employed by a U.S.

university, they can be paid as a university employee. Arrangements to pay stipends to international students not working at a U.S. institution are not allowable.

Q: Will the reviews be conducted in same fashion as in the past? For example, different reviewers for pre-application and full application?

A: Review criteria, as published in the FOA, has changed to focus more heavily on NE mission relevance. Relevancy criteria has changed to a determination about whether the application is relevant. That evaluation will happen before the application moves forward to technical review. Relevancy and program priority criteria from previous FOAs have been removed. All reviews after the relevancy check will focus on technical merit, not program relevance or priority.

Q: Is relevancy review still weighted as 40% of the total score?

A: No, relevancy will be evaluated along with a technical review and all applications will be determined as 'Relevant to NE mission' or 'Not relevant to NE mission'.

Q: How do PIs know what is programmatically funded by DOE?

A: PIs can reference several resources, including program websites listed in the FOA, program websites listed on the FY 2023 CINR webinar presentations, abstracts listed for all NEUP projects on NEUP.gov, and resources on the SBIR/STTR website. Any clarifications can be submitted neup@inl.gov.

Q: Will reviewers on relevance change from pre-application and full application proposals?

A: Reviews on relevance to NE mission will be performed by DOE program management. These reviewers typically remain the same during a review cycle.

Q: When will the opportunities for renewing existing projects that Dr. Huff mentioned start?

A: This is currently being evaluated and an implementation plan is being developed. DOE anticipates that this opportunity will be available beginning in FY 2024.

Q: If a PI submits two proposals to the same scope, perhaps one as PI and the other as co-PI or collaborator, will it affect the chances of selection?

A: There is no prohibition on submitting more than one application to the same topic or sub topical area. The one exception is the applications that are submitted need to be substantially different from each other. Meaning that they should be different scopes of work, different proposals, so to say. It doesn't have a bearing on the selection of applications.

Q: Would NASA Glenn Research Center be eligible to be the subrecipient of R&D led by university?

A: In the work scopes of Appendices A and B, non-universities may be sub-recipients of university led applications/projects. Only universities can apply as the prime recipient for the work scopes in Appendices A and B.

Q: I have a question about the R&D pre-application related to the "publication" document that is supposed to be submitted alongside. Is this document only needed if I was a PI before for a DOE/NEUP project? For example, I have been working on many DOE/NEUP projects with a prolific publication history in these, but was NOT the PI (grad student, postdoc, etc.).

A: You can list any publications that you have published under DOE/NEUP funding. When listing the publications, you can list what your affiliation was with the project (PI/Co-PI/contributor/post-doc/student) if you feel that would clarify a potential misunderstanding. I have seen many applicants separate their publications out in this manner in the past.

Q: Regarding the requirement to provide a list of publications and results from previous NEUP support, would this include projects in which I was a PI but my collaborators published? What if I was co-PI of a project and published?

A: Those publications from when you were lead PI are required. If you would like to include the lengthier list, we would be interested to know all publications, but that isn't a requirement for the pre-application.

Q: I have a quick question regarding the support letters from industry collaborators. The FOA E.9 seems to recommend them if applicable for IRP. I was wondering if I cannot submit these letters when I apply for non-IRP awards, Or I can do so, but don't have to submit them since they will not be reviewed?

A: You are correct, Letters of Support are only required for IRP. There is not a location specifically for these in the CINR pre-application, and if you do submit these for non-IRP work scopes, they will not be reviewed.

Q: Will the office hours sessions be recorded and posted?

A: Yes, the Office Hours recordings (when complete) are posted at neup.gov, specifically here (the second video displayed): https://neup.inl.gov/SitePages/FY23_Webinar_Presentations.aspx

If you use the link in the video to display in Youtube, you will see a menu of the various topic areas on the right-side column, where you can navigate to the topic area of your choice.

Q: For the Supported Publications document, do you want a list of the supported publications for just the PI, all university collaborators, or for everyone involved (including national lab and industry collaborators)?

A: The requirement is that you, as Lead PI, list all of your publications. If you have collaborator publications available, you can upload those as well.

Q: Are collaborations with national labs necessary or can teams just propose to have collaborators either within the institution or with other universities?

A: There's no requirement to have a national laboratory collaborator or an industry collaborator in any of the scopes for CINR. The guidance is to put together the best team for the work that you're proposing. That may include components like national laboratory or industry partners, or it may not. There are some topics that are well suited for universities and having a team of university people makes sense. There are other ones that would greatly be helped with having some of the national lab capabilities. Some of their capabilities are unique and they could potentially add to your proposal, but it really varies by the scope and there is no requirement. Pick the best team to make you the most successful.

Q: I have a question regarding the Benefit of Collaboration Document required for the pre-application of R&D programs. The FOA states "Please indicate within this section whether the application has benefit or influence on other ongoing or proposed NE R&D projects (e.g., modeling and simulation in one application and effect validation in a separate application). Is this only required for the primary PI? Or do I need to include the benefit on other ongoing or proposed NE R&D projects for the co-PIs as well?

A: For the Benefit of Collaboration document, the requirement is that this is provided for the lead PI. However, if you happen to have this information for other collaborators on the application, that information could certainly be included as well.

Q: For the estimated project cost in the pre-application, should this be broken down by labor, materials, overhead, etc.? Or just a rough order of magnitude on the total project cost?

A: Given that the pre-application narrative is limited to 5 pages, only a rough estimate on the total project cost is required. The full-application involves more detailed budget documents that will further break down the budget, so that type of detailed budget break down isn't necessarily needed at the pre-application stage.

Q: For the benefit of collaboration document, do we need to include personnel and facilities utilized from the same institution as the PI or is it only for external collaborators?

A: For the Benefit of Collaboration, if there are collaborations (even within the same organization as the lead PI), the collaborating personnel and facilities should be included. Please note the definition of a collaborator, as defined in the FOA (Part IV Section D.5), as collaborators should be identified in the proper pre-application documents and also listed in the Collaborators section of the application form:

"A collaborator is an individual who makes a defined, material contribution that is critical to the success of the project and/or contributing to joint publications. Any individual appearing in the project summary, technical narrative, benefit of collaboration, coordination and management plan, or budget documents should be listed as a collaborator directly on the application form. The applicant must have the full consent of all collaborators prior to submitting an application. Any individuals that do not meet these criteria should not be listed as collaborators on the application."

Q: If we have to reach out to federal point of contact for a different work scope can we get their e-mail or do we have to just e-mail that one single e-mail, NEUP@inl.gov?

A: We prefer that you send the e-mail through NEUP@INL.gov. we do route those to the appropriate program managers. There are some federal procurement rules on those responses, for example we're recording this office hours session because answers to these funding opportunity questions need to be posted publicly. There are some situations where instead of a direct interaction with the federal program manager we can help you along like by making sure that you understand the rules before we give you an answer on how it's going to be posted publicly and revising questions if there's details that may be inappropriate to post publicly.

Q: During the webinar I think Drew had said that if I have two ideas for one work scope I can put two proposals under the same work scope. Is that correct?

A: That's right. The restriction is you can have your name on no more than six applications and you can have your name on no more than three as the lead PI. There are two things to consider within those six applications. The first is if you are planning to submit more than one application, you should not submit the same application to do two different scope areas, you should choose the best scope area that you feel it would be appropriate to submit that application to and submit it there. We have an internal process here if we feel like it doesn't fit in that category with permission from a lead PI we can make a recommendation to shift that to a different work scope area. If you have two very different applications that fall within the same scope area or the subtopical area, you can submit both of them as the lead PI or in a co-PI status on a second application.

Q: As a clarification, if the program manager decides that, between two proposals with the same PI, one proposal is suited for the other work scope they can move it to other work scope with the PI's permission?

A: Those are relatively rare circumstances, but we would never move an application without the PI's permission to do so. If for example, someone in this modeling and simulation area had something was very experimental that would fit better in the fuels category, that's a conversation that's had here internally and if it's seen as beneficial to the application to move areas, then we would communicate that back to the PI and get permission from the PI to move it to a different category.

Q: In the webinar someone mentioned that all the scopes are up to three years and $1,000,000. Is it possible that if in the proposal we want to focus on one thing that can make the budget lower, maybe around half of the million or maybe two year, would this be preferred from a program perspective or would we still want to keep a big proposal at $1,000,000 and not go down the scope and the budget?

A: The up to languages is intentional. From that perspective what we would like applicants to do is make a determination based on the scope of the project that you propose to target the number of years and the and the budget in a realistic way. Having a more focused, more limited scope that may be lower dollar amount would not have an impact on how the application is reviewed.

Q: I have a question regarding cost sharing. I know that cost sharing is not the requirement there, but if we have cost sharing can we count the hours of industry partners or does the cost sharing only include the cash contributions.

A: There's a two-page guidance document in the funding opportunity detailing cost sharing. There are a variety of different types of cost sharing opportunities that you can identify including in kind cost, equipment, or cash type cost sharing. If you have any specific questions about the specific situation you're thinking of, you're welcome to e-mail those to us and we can work with the DOE Idaho representatives to get a clear answer about what's considered appropriate cost share and how you would communicate that in a budget.

Q: If we choose a sub-optimal work scope, will my proposal be moved or recommended later to a better-fit work scope, at the review stage?

A: The PI is responsible for choosing the work scope they feel best aligns with their proposal. After submission and upon review, if the Federal Program Manager feels the proposal would fit a different work scope better, the Program Manager could make this suggestion and the proposal could be moved only with the consent of the lead PI.

Q: If I have two PI proposals under the same topic but different subtopics (eg. RDO-1 and RDO-6), will they have conflict/compete with each other?

A: Different work scopes under the same topic area do not compete/conflict.

Q: Based on the FOA, it asks to provide the estimated cost of project in the pre-application narrative. Do I need to provide the specific cost of each items or years, or just the total estimated cost of the project? Also, when I was trying to input the collaborators information in the application system, it asked me about the funding information. Is this funding information meaning the budget from this proposal for each induvial collaborator? Is there any other information I need to include?

A: Given that the pre-application narrative is limited to 5 pages, only an estimate of the total project cost is required. The full-application involves more detailed budget documents that will further break down the budget, so that type of detailed budget break down isn't necessarily needed at the pre-application stage. Yes, the amount of this project's total funding allocated to the individual collaborators is what should be included in this portion of the application form. It is understood that this is an estimate, so please provide your best estimate at this point.

Q: For the filenames which ask for an ID#, should we use our institution's Unique Entity ID (UEI)?

A: No, the "ID#" you would use in the file naming convention would be the application number that is automatically generated for you in the application system. This should start with "RPA-23-xxxxxx".

Q: For NEUP preapplications, for each collaborator, do we have to specify the 'Funding' amount under 'Funding' on the NEUP webpage while submitting the preapplication? Is that a mandatory question?

A: Yes, please provide your best estimate of the individual collaborator's funding level. You won't be held to this funding amount, but your best estimate at this point is all that is needed.

NSUF Overview Q&A

Q: Several types of NE research do not fit within the NSUF mission (i.e. thermal hydraulics) but require reasonably expensive equipment ~$100k. Does it mean proposals under these topics will always be hindered by a lack of ability to be valuable to NSUF (general infrastructure)?

A: The Scientific Infrastructure FOA invites applications that are applicable to NSUF's mission and other infrastructure improvements that support research and education at universities. Education-related requests are not hindered by lack of connection to NSUF mission applicability and a dedicated criteria evaluation rewarding education-related infrastructure improvements.

Q: I understand for the NSUF Access-Only proposals the LOIs are due on 9/27. However, for a full R&D proposal that seeks to use the NSUF user facilities, is the LOI required? Or is language just included in the R&D Pre-Application due 10/11 that the work will leverage an NSUF user facility?

A: If you are intending to submit an application for NSUF, a LOI is required before submitting an NSUF pre-application. In addition, only invited NSUF pre-applications may submit an NSUF full application, so the LOI and pre-application are both required for this process.

Q: The CINR FOA states that NE will fund approximately $3M in value for NSUF projects, while the maximum value of individual NSUF awards is $4M. It also states than NE anticipates making 2 or more awards. Is this a typo since the individual award ceiling is greater than the total funding?

A: There is not a typo regarding this information in the FY23 CINR FOA, largely because the amounts listed in the FOA are estimates. While the maximum NSUF award size would be $4M, that would be extremely unlikely and most award sizes will vary (and be much less), which is why the FOA indicates multiple awards are anticipated within the $3M budget (which is also an estimate).

Strategic Needs Blue Sky Q&A

Q: There is a little concern about the amount of funding and the funding being spread across multiple PIs and multiple universities. And so, for the Blue Sky topics, will a single PI proposal be possible?

A: Yes, that's never been precluded. We've funded single PIs before in many different work scopes.

Q: Does Blue Sky focus on R&D projects? Or are educational efforts under workforce training also applicable?

A: Educational items are okay if you can justify it as being critical. Workforce training and education does fall within the NE mission.

Q: Are collaborations with National Laboratories and Industry allowed and encouraged?

A: We always encourage that, but for half a million dollars, it's going to be limited to what you can do because, at most, 20% of the project can go to industry or national labs. So out of $500K, that's $100K which is a very limited amount.

Q: Does a Blue Sky project count towards the six applications a PI can submit?

A: It is part of the CINR standard R&D number of projects. Again, no more than six applications with no more than three as a Lead PI.

Q: Will a multi-disciplinary research across the boundaries of the three topic areas, or other disciplines such as nuclear materials be considered?

A: Materials doesn't appear here directly. There are lots of other places where you can submit material type projects. You could submit multi-disciplinary projects to each one of the these and tie them together somehow but if one gets funded and others don't then you are kind of hurting. You'd have to have a pretty good strategy for linking all these together if that's what you want to do.

Q: If two strong Blue Sky projects come to the same scope, say Reactor Physics, is it possible to fund both? Or is it just one Blue Sky project per scope?

A: We don't know what the budgets are. We're committed to funding at least one in each area. If more money becomes available and we have two outstanding projects in any work scope, we will try to select two.

Q: Do the same limits apply for Blue Sky as the rest of CINR? So, in other words, can someone with an IRP apply to the strategic needs scope?

A: The same rules apply. If you go back and look at those rules, the strategic needs are the same as those for any other project.

Q: Could nuclear chemistry include coolant?

A: If the chemistry you are focusing on is the chemistry in the coolant, then yes.

Q: If a proposal passes the relevancy review, recommendations will be purely decided by the Scientific and Technical Merit? Is this correct?

A: That is the goal of the program as it's being shaped up right now. That is true.

Q: Can I submit multiple applications under Blue Sky as a PI under different scopes?

A: Yes. Each of SN-1, SN-2, SN-3 are all separate scopes so you could submit to each one. But you just can't go over your total limit of six, or three as a PI. You can also submit multiple to the same scope area as long as they are materially different applications. Those submitted to different scopes have to be different proposals.

Q: It appears the projects can be high risk as they are advertised. So, for example, if the concept turns out to be not effective or the project did not yield promising results, does this affect the PI's chance to get future DOE projects awarded?

A: These are research projects, so we know some are not going to yield super results or pan out the way they originally were thought.

Q: How many applications can a single PI submit as a lead PI?

A: Three to the entire CINR. Three applications total if they satisfy all the criteria. Eligibility criteria will be explained in the FOA. Applicants are encouraged to look at the eligibility criteria. There is not a different set of criteria for the Blue Sky Strategic Needs scopes. It is one set of eligibility criteria. These blue sky applications would count as application submissions.

Q: What is the recommended pathway to determine if the Blue Sky is mission relevant? Also, how would one avoid overlap with existing programmatic funded projects?

A: That is why we have the pre-application process. You submit the pre-application and you find out if it passes the mission relevant question. If it is deemed relevant, then it goes forward for technical review. If it's not relevant, you can still submit a full application if you correct it.

Q: Multiple proposals under the same scope, for example- thermal hydraulics, can be submitted by the same PI as long as the proposal topics or contents are different? Is my understanding correct?

A: Yes, it has been allowed in the past. They have to be significantly different though and justification needs to be given. They could not be the same proposal.

Q: Due to the issue associated with the pre-applications taking a full spot, if the pre application is not considered relevant, are we able to change the topic, or is the spot essentially used up?

A: It is essentially used up. If you submit a pre-application, you can't switch something and submit somewhere else. It has to be in that same work scope area, if you decide to go ahead and submit anyways. As long as the application stays on topic between pre-application to full application, more detail can be provided, and it can be altered to be more relevant to NE mission in between those two phases. Scope area can't change, per se, but it could look significantly different after revisions are made

based on feedback. You can't be writing a totally new proposal if one was rejected. That wouldn't be fair to everybody else.

Q: Are letters of support needed and should they be uploaded from industries for university-led projects?

A: It would be important if they're integrated somehow, whether they're receiving money or not, that would be another question.

Q: I feel that optical basicity can be a powerful tool to elucidate actinide chemistry in molten salts, but it is not well developed yet. Is this the type of thing that may interest the Blue Sky program?

A: It is up to the applicant to make the case (for Blue Sky and other open work scopes) that the proposed work is new, creative, important, applicable, and useful to the NE mission.

Q: Is there any direction on whether these topics should have a strong educational component in terms of not research, but teaching? The description starts out as maintaining fundamental skills and knowledge and key nuclear engineering topics.

A: Our program, except in the infrastructure area which does have educational component, typically doesn't have educational aspect, but I don't think it's excluded entirely in this case.

Q: When it's so open, there's no technical description here, I think I might struggle trying to demonstrate relevancy. How would we describe relevancy to the program when there's really not a description for it?

A: What we're looking for from a relevancy standpoint is to explain how the research ties to the NE mission. The intention of creating such a broad call is to focus more heavily on the technical evaluation and have less of an emphasis on specific program priority or program relevance. The emphasis is shifted to the proposer to make the case that their proposal is critically important to the success of any of the reactor types or of kind of technologies that are used in the nuclear energy sector.

Q: Since this is Blue Sky, which means pretty much you can propose anything, is this is going to be similar review procedure as the other CINR scopes?

A: Strategic Needs Blue Sky will not be reviewed any differently than the other areas.

DECP FOA Overview Q&A

Q: Can applications simultaneously address more than one of the three areas outlined?

A: Each application is encouraged to address as many of the focus areas that we have.

Q: If a person received their PHD in December of 2015, would they be eligible for this year's DEC program?

A: It would depend on how the dates line up. PIs must be untenured assistant professors on the tenure track and no more than seven years beyond their doctorate. PIs must be in the eligible position as of the last day of January 2023.

Q: When is the seven years beyond a doctorate counted from? The date of application?

A: PIs must be untenured assistant professors on the tenure track and no more than seven years beyond their doctorate. PIs must be in the eligible position as of the last day of January 2023.

Q: Are post docs ineligible to apply?

A: If they don't have faculty status and if they're not assistant professors, they can't apply. It'll have to be a full-time assistant professor position on a tenure track only. Postdocs are not tenure track.

Q: Will the requirement to not have received any previous equivalent career award still exist in this funding opportunity?

A: Yes, that is still a requirement.

UNLP Overview Q&A

Q: Is the fellowship limited to students in their first year of a graduate program? Or can more senior students apply as well?

A: Yes, the Fellowship RFA is restricted to students entering either their first or second year of overall graduate study.

Q: Are students enrolled in thesis-based Master of Science programs in nuclear engineering eligible for application?

A: Yes, Masters and PhD students are eligible to apply.

IRP-1: Grand Challenge IRP- Accelerating Reactor Development

Q: Will the Federal Points of Contacts provide a full, exhaustive list of duplicative funded projects?

A: The intention of these presentations, including the weblinks that have been provided, the NEUP projects that are available, and the abstracts available on NEUP.gov, is to provide that context. It is reinforced that the federal points of contact are listed on the draft work scopes and we do plan on having additional engagement opportunities to continue to ask these questions if there are clarifications after you have looked through those resources. As a reminder, we do plan on organizing an engagement opportunity as well as what we are terming "office hours" to have the ability to have those open conversations with program managers about what potential ongoing work there is and give any investigator or any potential applicant the opportunity to ask those direct questions. The shifts that we have made in the program this year creates an environment where there is more of an NE mission relevance focus, rather than a program priority focus. It is an important distinction from an administration standpoint and from a review standpoint as those things are evaluated. The hope is for the continued engagement to give you the opportunity to make any clarifications needed.

Q: Is it possible to combine different scopes of the IRP if they are related? For example, design optimization and reducing O&M costs? Also, is it possible to negotiate the budget beyond what is specified?

A: For the first question, it really is going to depend on how the proposal comes in. It has been seen where an applicant will want to shore up two different areas so they may address both of them in their proposal, making reference to another area. A good example of that would be advanced reactor design and fuels. You may want to submit something in fuels while you also want to submit something in advanced reactor design. You would want to ensure that there is no need to have any crosscut of one area in an IRP and another area. You would submit one with IRP-1 and then you would make reference to it in the fuels and submit it over in fuels. There is no combining, merging or pieces and parts that we are looking for. We are looking for a clear delineation between each one of these topics and subtopics. The Accelerating Reactor Deployment IRP is rather broad. There is the ”other” category in each topic area in case something is crosscutting and you feel like it doesn’t appropriately fit in a specific sub topical area. It is different if the intention is to apply to a crosscut, but if you’re going to try and force the crosscut by merging other areas, it is encouraged to try and look holistically into the areas and see if they can just apply directly.

For the second question, it is not possible to negotiate the budget beyond what is specified. The limits that are set in the start of the presentation are the upper limits for that budget and time duration.

Q: For IRP-1, are we looking at reactor siting or reactor design or licensing? Or if we improve operation and maintenance for an advanced reactor, is this considered accelerating reactor deployment as well and also responsive to this?

A: All of those would apply. If you're going to put things in there like maintenance, you have to be specific to how it accelerates development; Does it cut down on time? Does it help licensing? What are the impacts? When you're bringing something out over something that is existing for a new advanced reactor deployment, it may be a bit difficult. Reference and make sure that that you have the breadth and depth of understanding. If you don't have much of that information, you could certainly reach back out and we could try and give you as much information that's in the open space.

Q: If we pick a reactor design and then propose to make some improvements on it, is this also responsive for IRP-1?

A: While there aren't many things that I would say are limiting in this scope, modifying a design doesn't necessarily mean it's accelerating reactor deployment. If you're modifying it, and as an example are going to take a current design of some reactor and take the Henry Ford concept and build out smaller pieces, plug and play, which would cut down on manufacturing and shipping cost, that would be perfect for an example. But again, you would have to explain in depth what that means.

IRP-2: Grand Challenge Research and Development at Minority Serving Institutions (MSI)

Q: There was mention of broad student involvement. can you elaborate on that and what it means?

A: Students are involved with all research going on with a university. For example, NNSA has a collaboration with MSIs and sends their students to national labs for a summer or something similar for a semester. That is the only funding they provide. They don’t fund any research, per se, at the MSI. We

are trying to develop a capability at the MSI as well as keep student involvement high. It is up to you to define that and how best to do that.

Q: Are we expected to partner with DOE national laboratories?

A: It is not expected, but it is a possibility. You might get the national lab to throw in their own money on something like this. It could help the budget.

Q: Are equipment purchases allowed on for this IRP?

A: Just like any other IRP or R&D project, equipment purchases are allowed.

Q: If a minority serving institution is also a research university, will it be eligible to lead?

A: The answer is yes. As long as you meet the criteria listed to qualify as an MSI you can certainly do that. We can't say how any application would be viewed by the review committee, that's another question, but you can apply and lead.

Q: For the Grand Challenge at Minority Serving Institutions, can proposals focus on one class of materials that have applicability in a wide range of reactor types?

A: Yes. We're asking you to define what that challenge is and certainly materials is always one of those problem areas, whether it's cladding or structural materials or anything else.

Q: Would a team of multiple MSIs be accepted or is it expected that the team would include a non-MSI?

A: The rule that was set up is only 20% can go to a non-MSI, so 80% of the money has to go to MSIs.

Q: Where can we find the list of MSI institutions?

A: There is a Department of Education federal list that defines various MSI kind of categories and will most likely be put in the FOA. That list can also be found here. As long as you can justify yourself as an MSI and your partners through that Federal Department of Education website or list, we're ok. It typically is listed with the link to the Department of Education website. There are some other helpful resources, such as Rutgers University, they keep an MSI directory. If there's questions or you feel like your university has been excluded from the Department of Education list, there is a process to contact DOE to provide information about potential MSI status to be evaluated by the department. The statute for those MSI lists is defined on that Department of Education list and is available for you to look through. If there is information you can provide where the department can consider those factors, then that would be information that you can provide to the NEUP office, and we can have that evaluated by the department.

Topic Area 1-Reactor Development and Plant Optimization

Q: Is NEST participation considered a positive in the proposal evaluation?

A: Participation in NEST is not a consideration when we review proposals. NEST is an opportunity that is provided for students but is not part of the relevancy review and is not factored into our decision-making process.

Q: Follow-up question about the NEST participation. If it's not considered during the proposal review, why is not a favorable part of the evaluation process?

A: With the NEST program, we are providing an opportunity for students where they can travel to other NEST countries and to interact with their peers. The selection of the NEST projects is completed after the CINR review is concluded. During the application process, you will indicate if you are interested in NEST. We wait until we select the CINR projects, and we decide which ones are going to be selected. Then if any of those indicated their preference to be part of the NEST project, the NEST program would consider those. It does not impact the relevance of the work. It is an extra pocket of incremental funding that can be provided for travel.

Q: As a new faculty member coming from outside of the US, with a background in data science and advanced nuclear design, and currently working in the data science industry, developing prognostic, optimization methods for nuclear systems, is there any chance that I can reach out to the Federal Point of Contact for potential feedback on ideas?

A: Federal Points of Contact are available to answer questions focused around understanding current ongoing work and program activities, as well as better understanding NE mission space. When it comes to getting feedback on specific proposals, that is what the pre-application process is intended to do. If you were unable to catch the presentation from August 9, 2022, on how the review process functions, please reach out directly to the NEUP office at NEUP@inl.gov and we can walk you through that process. The intention of the pre-application review process is to give an opportunity for feedback and evaluation of specific proposals and concepts. Outside of when a solicitation is open, the federal managers can be available to discuss ideas. During the period when solicitations are open, we cannot give anybody an unfair advantage. When we are talking about applications to a funding opportunity, there are specific rules that all federal points of contact and federal employees must abide by.

Q: Are there restrictions on citizenship for PIs?

A: The requirement is that applications come from US institutions, meaning US universities or colleges, national laboratories, or industry. That means the requirement is on the institution to be a US institution. We do not have requirements on specific individual PI, co-PIs, or collaborators from that perspective.

Q: Within the RDO subtopics, is an economic assessment required for all work scopes?

A: The economic assessment is only a suggestion, which is something you can consider in your proposal, but is not required. In RDO-3, an economic assessment would be within scope.

Q: Is there an estimate on the number of possible awards for these work scopes?

A: We estimate there are going to be between 40 to 45 awards over all of the work scope areas. However, it all is dependent on appropriations and the amount of available budget to be able to make those determinations. We have a broad estimate but do not have any details in regard to potential number of awards.

Q: Is it expected that NRIC will be involved in these proposals?

A: The universities have the opportunity to engage with national labs as appropriate, but NRIC participation is not mandatory, just like national lab participation is not mandatory.

Q: Does structural design optimization cover the "nuclear fuel" structure as well? Or is it more about a bigger structure?

A: In regards to structural design optimization, it could include fuel design, but I would encourage applicants to review the other CINR scope topics to ensure their proposal isn't better suited for those categories.

Q: For all of RDO, is there an expectation that we would team up with a utility or a reactor vendor, a reactor design company or something to try to show near term application or can these topics be a little bit further out or not immediately applicable?

A: For RDO-3 I think there would be a benefit to teaming with industry. There's not a hard requirement, but having that partnership is beneficial for making sure that you can get really high-quality information on the industrial plant you're looking at. And just to add to that in general there's not a requirement that you team with the university or industry but there are some benefits in terms of near-term deployment. But that is not a requirement for the scopes.

Q: A question about the NEST program, the paragraph that describes NEST is just not very clear to me. What is the opportunity with NEST? Is this additional funds on top of the $2,000,000 proposal budget?

A: The opportunity with NEST is post award, this is not included in the up to $1,000,000 budget. It would not be part of the evaluation of the application. You can think of it as a tag on opportunity after the projects are awarded to engage with NEST for added student engagement. There are additional resources and funds through NEST to create those partnerships on awarded projects in the areas where that NEST language has been added in the funding opportunity.

Q: In the application to this program, we would indicate if we would be interested in participating in the NEST program, but we don't need to have any more information, is that correct?

A: That that's correct, and it is not part of the evaluation criteria. Whether you choose to or choose not to include that language will not have an effect on the evaluation.

Q: For the RDO scope, we noticed there is a grand challenge for the IRP scope in nuclear research, that is also saying accelerating deployment advanced reactors. What do you really want to distinguish between the RDO and the IRP for this year's call?

A: In general IRP's are meant to be more expansive. We would expect to see more extensive teaming between you know national labs industry and different universities. We also get more funding with an IRP so you can look at more activities and more items related to advanced reactor deployment and acceleration. It all depends on whether you're looking for a smaller scope, in which case the RDO would be more applicable, or if you're looking to do something more expansive with a more extensive team than the IRP would be the better option.

Q: Is any specific reactor being focused on either RDO or IRP?

A: No, we're looking for any nuclear reactor. Any of the advanced reactors, microreactors, molten salt reactors, fast reactors, high temperature gas reactors would be applicable. We're also looking to support the current fleet so, the large light water reactors would be applicable as well as the light water SMRs.

Q: Just one clarification, RDO is just for advanced reactors, right? Do water cooled SMRs qualify for that?

A: RDO-1 is specific to advanced reactors; it would cover both the light-water SMR's as well as the non light-water reactor concepts. There are also scopes within RDO that apply to the current fleet, RDO-2 specifically, does include the current fleet of large light water reactors as well.

RDO-1 – Advanced Reactor Development

Q: In the presentation of RDO-1, Advanced Reactor Development, new reactor designs are not considered to be relevant. However, "innovative reactor core and systems of design or modifications" is included in the draft work scope. Could you clarify the difference between these two?

A: It would be okay to propose modifications or improvements to current reactor designs, however, only in terms of focusing on a design exercise for the particular proposal. If you can make a case for why it is needed and how it supports the goals of RDO-1, then that would be considered as well. We are really focused on optimizing current designs and not so much creating new reactor designs.

Q: I was just curious about RDO-1 in particular, what are your thoughts on how much emphasis to put on the material structure that we start with and how to avoid overlap with all the materials subtopic areas. In other words, can you help us distinguish between RDO-1 and NM-2 or NM-3? For example, if you're primarily interested in the material response as for a particular reactor application domain and particular conditions how do we make sure that it doesn't overlap with the manufacturing method?

A: For RDO-1, we are interested in activities that would help to reduce the technical risks for advanced reactors, so there could potentially be some material related topics that could reduce the risk for advanced reactors, but you would have to clearly describe how your proposed activities would help to reduce the risk for those reactors. If you're looking more so at material focused activities such as advanced manufacturing like you mentioned, then that might fit better within the materials related scope. It really depends on whether you can show a strong tie to reducing the technical risk for advanced reactors, which is the emphasis of RDO-1.

Q: As a follow up, where would, for example, the creep and fatigue performance of materials that has high risk in application would that fall more under RDO versus NM?

A: That could potentially fall under either one. It depends on how strong of a tie you can show it to reducing those risks. As long as you can show a tie to how that will help accelerate advanced reactor development, then it would be applicable to RDO.

Q: Regarding the materials listed in the slides from the webinar for RDO-1, is the call agnostic to the ones other than the ones that are listed in the slides when it comes to the reactor component and the type of reactor we're looking into? Can you comment on the material system?

A: We're not requesting any specific alloy, we're leaving it up to you to propose what you think would be most applicable, but you do need to show a tie to how your activities will help to reduce technical risk for reactor concepts. You would need to tie whatever material you propose to us to supporting at least one of the advanced reactor concepts.

Q: The workscope is focused on limiting technical risks for advanced reactors, so do project that address challenges that apply to licensing issues fall within the scope of limiting technical risks. Specifically, the impact of salt property uncertainties on reactor performance during beyond design basis or other accidents?

A: Work scopes are purposely written very broadly to encourage innovative ideas. RDO-1 is focused on reducing technical risks for advanced reactors. In many instances, reducing technical risks and addressing technology specific gaps in licensing technical requirements, will also support licensing activities and help reduce regulatory risks. It should also be noted that work scope LS-4 is focused on activities that can reduce the regulatory risks for advanced reactors, including addressing technical questions which could come up during the licensing process. For proposals submitted to RDO-1, it will be incumbent on the applicant to explain how their proposed activities will reduce the technical uncertainties associated with advanced reactor designs.

Q: Does the project need to focus on a reactor that is coordinating with the NRIC or can other relevant reactor designs be considered?

A: The project does not need to focus on a reactor that is coordinating with NRIC. Activities relevant to any advanced reactor design (non-light water reactor concepts or light water Small Modular Reactor concepts) could be considered. It should be noted that design activities to enable a completely new design for the entire reactor system including the reactor core and any periphery systems needed to support reactor operation, are not considered responsive to RDO-1 but could be submitted to RDO-6 or IRP-1. RDO-1 is focused on activities to reduce the technical risks associated with advanced reactor designs.

RDO-2 – Improving Economic Competitiveness

RDO-3 – Integrated Energy Systems and Industrial Applications

Q: Does RDO-3 focus on developing reference designs or developing of methodology?

A: RDO-3 focuses on reference designs. This is not an artistic rendering. This implies using or developing requirements by inference from current regulations/standards, engineering or scientific analysis on risk and other relevant factors; and then designing reference designs to those requirements.

RDO-4 – Remote Deployment/Dedicated Power Supplies Including Siting

Q: A question for RDO 4, the scope of this call is a bit broad like focusing on environmental justice, for example, on siting technoeconomic analysis. If we propose a methodology that integrates one or two of the scopes described here, is this still welcomed or do you want to focus on just one of those multiple scopes provided here?

A: The ideas that we proposed were just meant to spark some innovative ideas and to give you an idea of what we're looking for. It's up to you what you decide to focus on. If you want to look at one or want to look at two or multiple, if you want to look at something that's not on that list, as long as you can show a tie to remote deployment of advanced reactors that would be responsive as well.

RDO-5 – Implementation of Artificial Intelligence and Machine Learning

Q: In RDO-5, a specific topic is on the list of current DOE support. For example, the autonomous operation based on artificial intelligence is already supported. Can we apply for that topic?

A: Applicants should review the ongoing research in the area of development of semi-autonomous and fully autonomous reactor operations. There is plenty of landscape necessary to complete that task. Applicants would not be discouraged from pursuing that scope but we would encourage them to review ongoing research in that area. If applicants reach out to the NEUP email, program managers can forward additional information regarding ongoing work.

For all work scopes, applicants should not rule anything out because it is listed as currently submitted. We're looking to spark innovation here so if there is a better and improved way of doing something compared to what we're currently supporting in the program, that would be considered responsive. We wouldn't want to find the exact same scope or the same way that we are currently doing it, but if it's something that's new and different, that would be considered responsive.

Q: For RDO-5, would a combined AI/ML experimental proposal be of interest?

A: Potentially, yes. For that subtopic, it isn't limited to only having an AI/ML component. The idea behind this subtopic is to encourage the AI community to support that in the Office of Nuclear Energy Mission. If that proposal included an experimental portion to validate the AI/ML techniques, then that would appear responsive to the subtopic.

Q: For RDO-5, does structural design optimization include topology optimization?

A: For topology optimization, I would encourage whoever submitted the question to expand and clarifiy on what specific topology they are referring to as it may be applicable to the scope. Based on the question alone, it's hard to tell and would need more clarification in order to answer the question.

Q: Is RDO-5 seeking the development of an ML/AI method that will solve specific problems or more about the application (using an existing ML/AI method for solving a specific problem)

A: RDO-5 leaves room for applicants to propose development of novel AI/ML methods or to utilize existing methods and apply it to nuclear energy. In both cases, we want applicants to explain how the technique will successfully support the NE mission. For the scope topic, we intentionally left the language broad, so that we would not limit what nuclear applications applicants could target. We welcome applicants targeting a known need in the nuclear industry but will also accept proposals that define a novel identified need.

Q: This question is about RDO-5. We're interested in applying Machine Learning to materials, especially to graphite. In the context of high temperature gas reactors is that of interest to this subtopic?

A: It would be of interest. It would potentially fall under another topic area if it could support code validation such as moose, under a modeling and simulation topic. RDO-5 is meant to be more of a broad and open scope for any AI/ML related topics that applicants are proposing that don't fit under another specific category, we wanted to make sure that we didn't limit those who are applying to the NEUP scopes that could be basically excluded because of their topic ideas. M&S-3 which might be applicable but RDO-5 because of the artificial intelligence/machine learning nature might also be the right avenue.

Q: For RDO-5, Would a digital twin comprising AI/ML technology to understand structural or material properties be relevant to these subtopic?

A: That seems to intersect with a couple of different scope topics. A characteristic of RDO-5 is that it's supposed to cover cross cutting developments that really don't fit under one specific category but target a lot. It sounds like based on what you described that potentially the RDO-5 area may be the best place to apply, but again, review the other scope topics to make sure that in your opinion it is the best place to position it. But due to the cross-cutting nature of what you described it, it appears that it aligns with RDO-5's intentions. The intention here is for you all to make a decision about where the best fit is for your application based on how you read the scopes. There will be an opportunity once program managers have these in hand to make recommendations about potentially moving them. You don't need to stress too much about how it's going to be viewed once it comes in internally. That discussion happens as all the applications come in.

Q: As part of the proposal, if we found that data analytics tools or methods like for example machine learning optimization algorithms would help to support the proposal, can they still be part of the proposal, or would that then fall under RDO-5? It's not going to be the central point of the proposal. They will be supporting tools.

A: If it's not the central point and it's just supporting, and the focus of the proposal is remote deployment, then I would say that it would fit better on the RDO-4. We would not exclude it just because it also included artificial intelligence items.

RDO-6 – Other Reactor Development and Plant Optimization

Q: Does the 'other' reactor scope support new reactor design?

A: This is something that could potentially fall under the IRP-1 work scope. Of course, you would need to make the case on how that design would accelerate the deployment of advanced reactors.

Topic Area 2 – Fuel Cycle Technologies

Q: Where would the fundamental radiochemistry of radionuclides go under?

A: It depends on what kind of application or purpose of studying that is. If you are just studying the irradiation effect, then FC-1 and FC-2 for refueling and reprocessing of repository and disposition. For storage and transportation then go to FC-3 and FC-4. If this is purely for scientific like blue sky, there is nuclear chemistry which is a strategic needs area. The work scope code on that is SN-3, you could go that route as well.

Q: If I understood correctly, NE-43 and NE-52 both talked about research in MC&A for advanced reactors. Can you explain how research is divided across those two offices? Is 43 focused on technology and 52 focused on processes? Thank you.

A: Both Offices support development of innovative MC&A related technologies and processes. NE-52 focuses on developing technologies for advanced nuclear reactors application and their associated operations. NE-43 focuses on developing technologies for fuel fabrication and fuel recycling applications. Depending on the main focus of the proposed R&D scopes, NE will decide a lead office to manage the proposal.

Q: During the Webinar, it was mentioned that the Integration Office may provide a list of previous SBIR/STTR projects funded by the MPACT (Materials Protection Accounting and Control Technologies) program. If possible, could you share the list?

A: The award listings can be found at https://science.osti.gov/sbir/Awards. They have the topic/subtopic number listed, as well as the topic title, and they are sortable spreadsheets.

FC-1 – Aqueous Separations Chemistry

FC-2 – Molten Salt Separations and Solution Chemistry

Q: For FC-2, viscosity and density were listed as properties of interest. Are other thermo-physical properties of interest such as specific heat or thermal conductivity?

A: Yes, those were given as examples. Thermo-physical properties, in general, tend to be more of interest under the fuels area, such as molten salt reactors. There is another area that Dave Henderson

deals with which also includes modeling and molten salts and they would fall under that. Other thermo-physical properties are of interest too.

Q: Are thermodynamic measurements of molten salts using calorimetric methods of interest?

A: Yes, provided that they are not repeats of things that have been well characterized already. We want to understand the properties of the salts as a function of composition and at the atomic level, if a bottling component is a part of that for explaining these things. It's always good to have good data to benchmark your models against as well. DSC type measurements and heat capacity are useful.

Q: For FC-2, among the molten salt systems are both chloride and fluoride of interest?

A: Yes.

Q: Are other systems of interest as well?

A: My experience has been with chlorides and fluorides. There are other high temperature molten salt systems as well. You are looking at different anions other than the halides. If you can justify this is for nuclear energy applications, we welcome that, but we use fluoride and chloride systems in most cases. Salt systems that are applicable to the EERE solar system we are not interested in.

Q: Of fluoride and chloride systems, which one is more important?

A: It depends on your application. I would say they both have multiple areas of interest to the Office of Nuclear Energy.

Q: Are there any particular salt compositions that NE is interested in?

A: We are not defining what should be of interest. It is up to the applicant to make that decision.

Q: Are mechanical properties of TRISO due to irradiation of interest? If so, what type of properties are of more interest?

A: TRISO is a solid fuel. Subtopic FC-2 deals with molten salt solution chemistry and properties at the molecular level. Therefore, mechanical properties of TRISO fuel due to irradiation does not align with this subtopic. I suggest you check the other subtopics for one that is more in line with your question.

Q: Utilizing hydrodynamics may be useful for studying speciation in complex salt mixtures. My team can both model this behavior and study it empirically. Would this be of interest to your program?

A: Perhaps, insofar as the hydrodynamics properties such as Reynolds number can be deconvolved into the more fundamental properties of the molten salt.

Q: Because FC-2 is focused on separations and solution chemistry, is the FC-5 workscope a better home for a joint compositional and thermophysical property analysis study? The end goal of the study would be demonstration of an instrument and capsule that would be used in an NSUF study to provide real-time data during irradiations to monitor fission products and actinides to improve safety and lower proliferation risk?

A: You are correct that FC-5 workscope has more of an emphasis on measurement and modelling of molten salt thermophysical properties as a function of composition and conditions than the FC-2

subtopic, which is aimed at improving our fundamental atomistic understanding of molten salt solution chemistry and structure. With the end goal you describe, the FC-5 subtopic would be more suited for a joint compositional and thermophysical property analysis study.

FC-3 – Spent Fuel and Waste Disposition: Disposal

Q: Is radio chemistry still being considered under FC-3 or FC-4? It seems like all of the examples focused on non-radioactive components of storage disposition approach.

A: Radiochemistry would be most applicable under FC-3. The disposal research is where we are looking at the groundwater and transport of the radionuclides that would escape from the waste package. We are looking at that in the geosphere and host rocks So, yes there is an issue there of radiochemistry in FC-4. The fuel rods that we are looking at are radioactive, but we are not really looking at the radiochemistry of the fuel rod because they are basically static at that point in time. We look at the off gases, but I don't think radiochemistry would have an application in FC-4. Again, you can always put it in FC-5 to see how it would crosscut with FC-3.

Q: For FC-3, is there any specific fuel that is considered more interesting? For example, is TRISO disposal of interest?

A: Our mission is to look at disposal of currently used fuel in primarily commercial nuclear reactors and that would include low burnup and high burnup of conventional uranium oxide fuels. We are also to some extent, at least on the disposal side, considering other DOE and DOD fuels. We're not looking at experimental fuels as that's not within our mission. So that would be a no to TRISO.

Q: For FC-3 and FC-4, is the degradation of high-level nuclear waste glass of interest?

A: High level waste glass form is typically a byproduct of the DOD waste. That is something that we are looking at. It is part of the waste package under the Performance Assessment or the GSA. That is not a topic that we are currently investigating. It is not directly related to the NE mission but I could see that it could be in the FC-5: Other topic if it could show how that would crosscut with our disposal mission. I would put it in FC-5 but I don't see it as directly applying to FC3 and certainly not FC-4.

Q: For FC-3, we are being asked to look at the Sandia road map, and in the road map there is a lot of language about writing radionuclide solubility do you consider radionuclide speciation, to be part of solubility?

A: Some of it because we're looking at almost a million years in computing things, so you would find a daughter products and others along the way. We should be looking at additional speciation that might be relevant. We have to make sure that what we are doing has a greater importance than a narrow research importance, it's got to support the performance characteristics. We are dealing with a lot of uncertainty in different parts of these things and it's not always sure that one dominant uncertainty reduction would really make any difference in the overall performance assessment. You pointed out to the road map; we have been putting out some five year plans we updated every year. You'll have to do a little searching for that which will give you a little more currency on where we are going forward. The

important thing is that we have been focusing on a program, mostly national labs driven, but you guys can go outside the box and see if we are looking at relevant things that are important downstream. As universities you have the opportunity to present your case that you addressed this in your five year plan, so feel free to do that. As a point of reference we have given you that road map and other documents and I would advise most of the folks on this call also to visit some of the documents we put out for GDSA, that is the geologic disposal safety assessment, that's the computational aspects that gives you some insights into a lot of the processes.

Q: When you talk about the geological barrier, Are you interested in understanding the fundamental behavior of a geological barrier?

A: For the engineered barriers, in studies we have been looking at saturated reducing type of environments and there we have used mostly a bentonite based backfill. For the natural barriers we're looking at argillite or crystalline and salt primarily, and some shades of inner shale and things like that. When you look at these things, you have to be careful what the function of these barriers are. For instance, the engineered barriers are particularly sensitive to temperature considerations because that's closest to the waste form that's put out there, which is relatively hard. There are more processes in the engineered barriers as the heat drives some of the things, the geochemistry, the software characteristics and things of the bentonite. In the far field, you look at the disturbed zone effects and then go into the system, the longer transportation or retardation, whatever it may be, in the natural system. The natural system consists of multiple layers of other things, too, or in the crystalline case, you may have a fault that is predominantly a preferred pathway for radionuclide transport. Focusing on one characteristic of one thing may compromise you on something else, so you have to be very careful that when you propose something it is additive in performance, not detractive from some other parts of the performance.

Q: For FC-3, this is about knowledge areas, for example, they talk about which package failure mode. In this case, if something is considered for any of these points, can we consider it better to put these potential failure mechanisms within a generic site or is there a specific site that you would like to see for those types of mechanisms?

A: Yucca Mountain was an unsaturated oxidizing environment. Most of what we have been looking at is saturated reducing environment. In this case we are not going to pick and choose a particular metal container, all we are going to specify is the geochemistry. You scan the entire work that's been done internationally and some of the chemistry parts could be either from Monterrey or any of these things. You would have a span of geochemistries to deal with in saturated things. The concept of containment is also different internationally. Some people say absolute containment, whereas in the US we had looked at how a waste package would degrade with time, either by corrosion, by fracture, or by any creep rupture. It may be that there's an opportunity for putting all of this in a perspective, to look at new science that we don't understand particularly for a long term application, because it may be sitting there in a saturated condition and the geochemistry may evolve in the near field. The earlier is high temperature driven and different constituents show up and later on it might be benign or flooded by something else.

Q: Is the NE office interested in more on post closure criticality? I saw it as a high priority in that Sandia report, but I have seen a lot of work from Oak Ridge, National lab on post project criticality.

A: The thing we have been looking at carefully is the DPC's, dual purpose canister. The idea behind that has been if we can dispose that directly underground. Dual purpose canisters right now are theoretically both storage and transportation. That's what Oak Ridge and Sandia have been working on, to see if there are any criticality consequences as a result of long term storage or moving. In the Yucca Mountain days most of what the regulations talked about was to keep it dry and keep it from moderator effects. So that was that was one driving the probability of having anything wet around it, that was one of the issues. Whereas now we are looking at saturated conditions and reducing conditions and in some cases they may create situations where any critical configuration of the heap or the fuel elements might cause criticality. We've tried to see if they can put some injecting things inside the DPC so it can be structurally safe, there has been some activity in that area from Oak Ridge, PNNL, and Sandia. The question about an integrated way of looking at how we can reduce the potentiality for a criticality event. Hand in hand is what if there is some criticality event, what are the consequences of a controlled event to just maintain a small you know like event that may just die off and not create a problem in changing the field environment.

Q: Is there's a potential now for looking at the materials degradation of the DPC's for the NE office? we are planning to propose something related to looking at the cask degradation because of the decay heat over the long term and analyzing this phenomenon related to stress corrosion cracking or for example, when we expect the DPC would fail under a certain decay heat level. Are these types of materials analysis of interest to the office for this year's call?

A: Yes, though be careful about knowing if there's a marginal effect it may not affect performance. When you explain why you want to do a certain thing, make sure it is performance related and note how much difference would it make. It is good to understand certain things and that has in itself some usefulness to the program to know what the effects of these things are. Some of the temperature ranges may not be at the state that will create creep effects on the free rupture. You have to go through a system analysis to see id whatever you're proposing is of good value to make the performance connection.

Q: For FC-3, we know the so-called the vitrification is important way to process or to immobilize nuclear waste over the long term and some hidden cavities will form in nuclear waste. Would a study on this topic will be fit for FC-3?

A: Vitrification has a lot of studies done already and the work is on vitrified glass for the high level waste not the commercial spent fuel. If you're going to be proposing anything particularly, with the glass cavitation or anything else, make sure it is significant enough to make a difference in performance. We would like to see your arguments on what the integrity of those cavitations might be of, whether it breaks up the glass structure or it creates a new set of problems but make sure it is performance related.

FC-4 – Spent Fuel and Waste Disposition: Storage and Transportation

Q: Question deals with TRISO fuels. It sounds like the disposition of TRISO fuel would not fall under FC-4. Would that fall under FC-5?

A: I would put it under FC-5, but our mission in spent fuel and waste disposition is to address current fuels which are the light water reactor fuels. Therefore, we would not be addressing TRISO fuels. It certainly would not come under FC-3 or FC-4. I don't know how well it would be received under FC-5 because it would not apply to FC-3 or FC-4.

Q: For FC-4, would both experiments and modeling of chlorine induced stress corrosion cracking be relevant to the NE mission?

A: Yes, that is something that we are looking at.

Q: Would a proposal utilizing ultra-high-performance concrete (UHPC) for SNF overpacks (vertical and horizontal) as a potential replacement for conventional concrete be appropriate for the FC-4 topic area?

A: Ultra-high strength concrete for SNF overpacks is a responsive topic. However, a primary function of the overpack is to provide radiation shielding, so developing a stronger concrete that facilitates designing a thinner overpack wall would not necessarily be advantageous.

Q: This question is about FC-4, I'm looking at the call and looking at Item 4 at the end of the description: stresses and strains on fuel bundle components due to transportation or seismic loads. Are you still interested in seismic performance on the storage facilities, because seismic loads probably wouldn't have any effect on the on the fuel bundle?

A: There is a lot of work being done on this. There's a shaker table test going on in Southern California on a program driven by Sandia, trying to look and see if all these transfer functions are adequately represented. What we are looking for is something we haven't considered. Some of these things tend to be almost design specific. We have done these things. At this point in time, just follow some of the programs we are doing through Sandia and find a way to step outside the box and see if there are things that we can do better, something very uniquely research oriented that we haven't thought of. The issues of seismic and bundle behavior are important in the sense that in storage if we are going to keep the container as is and put it in underground, that's a different story. Of course, the earthquake issues are probably a little less that deep underground depending on how you design the cell except the shear force. That's a slightly different question from the Shaker table stuff. One of the interesting things we want to make sure of is that the pellets don't crumble and create a potential criticality event eventually. The integrity of these internals is important to us. We are looking at different facets of it with the mindset of, is there a simpler way of doing it or is there a better way than the conventional way we're doing it?

Q: As a Follow-up, are all these new ideas is still are part of FC-4, not FC-5?

A: When we called that out under FC-4, part of it is relating to a lot of the testing we are doing so you can come in from the outside and say, hey, this is a better way to do something.

FC-5 – Other Fuel Cycle Technologies

Q: Is the development of alternative waste form for disposal of high-level nuclear waste appropriate to which topical area?

A: We are talking about disposing conventional spent fuel and high-level radioactive waste from currently operating commercial nuclear reactors. We, at this point, are looking at taking the fuel rods as they are discharged from the reactors. We are not looking at any transformation. Again, under FC-5, if you have something in that area you see addresses our mission in FC-3, propose it, but we are not currently looking at changing the waste form.

Q: For FC-5, There is no point of contact listed in the FOA, so I was wondering what are the specific topics that are covered in this category and more specifically about the molten salt waste forms? I understood from the introduction the effort is more so focused on speciation and the solution chemistry but what about the waste forms? Last year there was a call for the development of this waste form but what about the corrosion of this kind of notice or related waste forms are they of interest?

A: Regarding FC-5, for the other work scope areas, those topics could be pretty varied, so we decided not to put a point of contact on the other areas. What we would like you to do is if you have a question about what may or may not fit in the other category you can email NEUP@inl.gov and we as a university program team will route the question to the appropriate program manager who can then provide a response. That way we can get the right person for the specific topic area to make a response. Regarding the waste form question specifically, we do have a material call separately (Topic Area 7, NM-4) under Kimberly Grey for the waste form of the fuel cycle in that area. We do encourage folks to develop innovative waste form and offgas sorbent material in that area to submit a proposal. If it is applied to the waste form specifically you should go there, if it's about the salt corrosion issue you can go to Jim's program FC-2. If it's waste form performance, corrosion of the waste form that would be more appropriate for the material side.

Topic Area 3 – Fuels

Q: Are proposals that make use of fusion neutrons for nuclear fuel processing, so either TRISO or metallic fuels acceptable for this topic area?

A: No because fusion does not have access neutrons. They need to use every neutron to breed tritium so even if it goes around the corner, I don't see a concept where a fusion device is going to have excess neutrons, if that's the correct interpretation of the question. There is not an interest.

Q: Is advanced manufacturing of claddings, like FECRAL, of interest?

A: Absolutely. We have a lot of work to do in advanced cladding so any advancement in the cladding production technologies is welcome.

Q: Is there interest in MOX or adjust to uranium only kernels?

A: We have talked about MOX before so at this point, that is not of interest.

Q: Do the scopes in this call have a technical point of contact?

A: There were some technical points of contact who answered questions here on this call or identified in the presentation. The draft work scopes do not have technical points of contact listed as they are relatively broad and some of them are very broad. There are multiple different technical points of contact that could potentially provide feedback or answers in different formats, so we have not provided those individuals. We'd encourage you to reach out to the NEUP office at NEUP@inl.gov or the federal program managers as those central points of contact.

Q: Can a pre-application address more than one work scope? So, for example, if somebody wanted to submit an application to FL-1 or FL-2, along with submitting to NM-3, which is an advanced nuclear materials work scope.

A: If there is one application that is cross cutting through several different topical areas, the applicant is responsible for choosing the most relevant topic area. That's a question that can be extended to the NEUP office for clarification about how the other scopes work and how the other topic areas are so we can do our best to direct you in the best way possible. DOE does reserve the right with an applicant's permission to move a pre-application, for example, into a different topical area that is determined to be more relevant so there is a process that we can go through to do something like that. As applications are being reviewed, those types of discussions happen and with concurrence and approval, those types of changes can be made after pre-application submission.

Q: It seems that there is interest in testing irradiated matrix graphite performance. What conditions might be most relevant?

A: I recall this question being asked in terms of fuel matrix graphite oxidation. In this specific sense, an applicant could consult the AGR Irradiated Specimen Air/Moisture Heating Test Plan, which can be accessed via the INL library (https://inldigitallibrary.inl.gov/sites/sti/sti/Sort_14885.pdf). The test plan provides detailed information in response to that question, including the basis thereof. Applicants should also consider that industry vendors may be interested in conditions most relevant to their unique designs. As such, we encourage applicants to communicate with industry vendors who might share interest in the proposed scope. The generic conditions for an mHTGR that are of interest are similar to those defined by the AGR program performance envelope. This includes time-average fuel temperatures of ~600--1250C and fast neutron fluence of up to 5E25 n/m2 (E >0.18 MeV).

Q: In addition, we have two pilot scale molten salt loops, which could potentially support studies of salt interaction with matrix graphite or whole pebbles. Are either of these of interest to your program?

A: Potentially. We like to ensure that work scopes provide value to current work by the national labs and industry. Thus, we would advise applicants to collaborate with vendors who share interest in the proposed scope.

Q: Do you need neutron irradiation or is ion irradiation okay?

A: We prefer proposals that have prototypic radiation as part of it. Ion radiation is not established and carries with it a lack of prototypical aspects. With that in mind, we'd certainly be open to ion irradiation, just be aware that you'll have to address the challenges that come with it.

FL-1 – Accident Tolerant Fuels

Q: I do have a question for FL-1, does this work scope encourage computational model validation or experimental validation for the proposed projects?

A: What is preferred is developing the actual, experimental data that models can be validated to or developing new models based on better interpretation of experiments and things like that. We're not looking for code development. We're looking for model development that's generic or that can be applied to understanding the physics of what's going on for a specific phenomenon or interest for that research topic. Modeling can complement experimental work so it has a role, but it shouldn't be just the sole activity.

Q: Are proposals relevant in areas of longer term or near-term ATF options, considering the fact that long term ATF data availability is an issue? For example, silicon carbide composite cladding.

A: Yes

Q: In FL-1, are proposals based only on simulations acceptable to the FL-1 work scope to analysis reactor uprights?

A: Yes, I don't see an issue with that if you are very clear on the phenomena that you're targeting with the AFT design. I think that would make sense.

Q: Does FL-1 encourages the use of existing NE code suites or any validated commercial software?

A: As long as you demonstrate your basis appropriately, I think that's fine.

Q: In FL-1, are uranium carbide and uranium nitride of interest or relevant for this work scope?

A: Yes, those are long-term subjects that are of interest.

Q: Our interpretation of FL-1's caveat that "major changes in geometry are not included" (out of bounds) is that: The utilities must be able to implement the fuel without retrofitting any internal components; The fuel vendors must deem the fuel practical to manufacture."

A: That requirement refers only to the UPRATE item, in that a normal uprate activity could involve a system optimization action where not only the fuel is changed, but also the fuel assembly configuration could be altered, e.g. fuel pin and wrapper dimensions, as well as pitch/diameter ratio might also be altered. Items such as these should not be considered in the uprate item.

Q: Is the interest in NDE specifically in the manufacturing of silicon carbide composites and is there a particular manufacturing defect that is of concern (eg sealing the end-caps)? It would also be great to partner with someone that has firsthand experience in the problem. Is there anyone/anywhere specifically where this problem statement is coming from?

A: NDE of fuel cladding is always of interest. In Accident Tolerant Fuels, silicon carbide related cladding NDE may be a significant area where new techniques could be of value, and end- cap sealing verification

certainly is an important application area. It is important that you work with the Silicon Carbide cladding developers, and not try to reinvent any wheels.

Q: Would a new concept for accident tolerant control rods fit within the "FL-1: Accident tolerant fuels" or "FL-4: Other fuels topics" work scopes?

A: The FL-4 "others" sub-topic is new this year and is available for situations in which a proposal can be made, even if it doesn't align with other work scopes, that has relevance to the NE mission.

Q: Coming from a modeling background, what is the interest in fuel cladding interactions and newer kinds of cladding for example, the iron chrome aluminum (FeCrAl) as opposed to the traditional ones, zirconium and maybe metallic fuels? Are those interesting topics of interest?

A: Modeling is very important for all of us so that that that almost goes without saying. FeCrAl is of interest to us obviously in the in our ATF program, and I think in the long term some advanced alloys on the fast reactor side would be interesting as well. You're ultimate question on metallic fuel with advanced claddings for fast reactor type applications is a critical fuel performance phenomena in metallic fuel that we have a desire to have a better understanding of a better way to better way to model it. So that would be it would be of interest.

Q: As a follow up, as I understand that the fuel itself is still poorly understood. For the metallic fuels, uranium, plutonium, zirconium, to what extent is there interest in in addressing the thermodynamics of that from a first principles point of view?

A: There's been work and interest in going in that direction. Historically the metallic fuel is a product that we've been working on for quite a number of years. Most of that work was done in a previous generation where the first principles mod sim wasn't really an emphasis and most of the fuel design efforts were empirically driven and engineering driven. To a certain extent, getting back to backfill that understanding, we know how the fuel behaves but the kind of why's and how do we extrapolate from there, would be very interesting. I wouldn't go as far as to say we don't understand it. It's just that I think we don't have a fundamental characterization and descriptive tools that maybe we'd like to have that would help us expand the application of it to a new area. Additionally, FL-1 as the title goes is accident tolerant fuels, but there is the FL-4 area where you can come in with other ideas. That's innovative research that would enhance the safety and performance of existing LWR's.

Q: I'm working on the hydrogen permeation problem of accidental tolerant nuclear fuel cladding, which is FeCrAl cladding. This objective is not mentioned in the FL-1 areas of interest. My question is for this specific topic, do you suggest we submit to one or four which is the other fields topics?

A: At a high level, certainly the other subtopic area is there, but FeCrAl is one of the longer term concepts that's important to at least one or more of our vendors. Next generation fuels is certainly could be one of the candidates that would be of interest because the company that's interested in is also has some small reactors that it's developing. That's a known challenge for FeCrAl utilization in an LWR environment, it's something that many have expressed some concern over, so I think it clearly fits in that area. If you want to broaden the scope and think about its impact on other applications then it might fit better in the other space. But if you're framing your problem in the terms of an ATF technology and application, it fits very cleanly into that call area.

FL-2 – TRISO Fuels

Q: Is there any interest in technology development that could speed up TRISO fuel characterization, but the technology hasn't been implemented for use with irradiated materials yet?

A: That sounds to me like it could be relevant. Absolutely. In the US, the AGR program at INL and Oakridge have developed PIE methods for particles and advanced those in certain cases, but there's still room for further advancement.

Q: In FL-2, if the characterization technology was focused on measuring thermal conductivity of diffusivity, would that increase its relevance.

A: The main area where we're interested in thermal properties is the matrix itself, the bulk matrix. There are some interesting oddities about the thermal conductivity of the matrix that happens when you embed particles, and you get a very orientated microstructure around the particles. We really don't have very good data on the modern matrix formulations and what their thermal conductivity is so that's the main area. There's been discussion in recent months about thermal conductivity of the coating layers. The issue there is that it's got a very small effect on particle temperature and performance. Those are very thin layers. The temperature drop across them is very small and in modeling, some sensitivity studies that we did in the AGR program showed that you can vary some of those properties by an awful lot, a factor of around plus and minus 3 and 5 and it didn't affect the outcome of the failure prediction. So, I guess the answer is yes. If you're looking at matrix, the thermal properties are one of the primary areas that we are interested in.

Q: In FL-2 and FL-3, as part of advanced manufacturing and development of FECRAL claddings, can simulated ion irradiation testing be a part of the work?

A: It can definitely be part of the work, but as we said, the technology of ion radiation is far from established as far as it has massive, non-prototypic aspects that must be addressed in the proposal.

Q: Would TRISO fuel disposition be of interest in FL-2?

A: No. FL-2 scope includes areas relevant to fuel fabrication, characterization, and in-pile performance.

FL-3 – Metallic Fuels

Q: In FL-3, is cost effective manufacturing or fabrication of ODS cladding tube relevant?

A: Yes, it's highly relevant. That's a real Everest right now. That's the prime example of manufacturability. We can make ingots of ODS. It takes all kinds of mechanical working to preserve these oxide dispersions. It's a real challenge to get a shape we need so highly, highly relevant.

Q: Are both experimental and modeling work relevant for to FL-3?

A: Absolutely. There are some phenomena that challenge our first principles understanding, so there's two paths to go when you don't understand the first principles. You let it go. You give up and you do empirical work. That's acceptable in our field. And the other direction is you dive in and do fundamental basic, like separate effects testing, trying to get those fundamental principles. Both are relevant and it's a judgement call. We can't do empirical and modeling on everything so it's a judgement call on a case by case. Yes, it is definitely relevant.

Q: Will a proposal for enabling advanced cladding materials like ODS be of interest in FL-3? Like novel manufacturing route, followed by preliminary characterization and PIE to get the new technique to the next TRL.

A: NE has high interest in developing manufacturing techniques for ODS steels. Proposals would be expected to include adequate PIE to self-verify and report results.

Q: For FL-3, following on the ODS manufacturing question. Will a proposal be considered relevant if the newly fabricated ODS are not irradiated?

A: NE always prefers irradiations as part of a fuels proposal as that is the ultimate proof test. However, ODS suffers unique challenges regarding microstructure preservation during manufacture. Therefore, it would be acceptable to forgo irradiation testing to ensure adequate time and resources can be targeted to the core problem, manufacturability. As stated above, adequate characterization analysis should be included in the work scope to be able to have the grantee assess and report accurately on results. The proposal should indicate how follow-on work could be done to conduct irradiation testing of the product.

Q: For general metallic fuel, if we're trying to understand the radiation behavior, for example how the radiation affects the degradation of thermal properties, mechanical properties, and fuel cladding chemical interactions, would this be relevant to this topic area?

A: Absolutely. The fuel cladding chemical interaction right now is considered one of the most limiting aspects of metal fuels. We're very interested in understanding that phenomena and more importantly seeing techniques used to mitigate that and add life. We are looking at the idea of liners and getters. None of these seem perfect, but I don't want to limit you to liners and getters. But we are very interested in in the fuel cladding chemical interaction. Because the cladding degradation is such a limiting factor there's not much concern for the mechanical properties of the fuel itself. If there was a phenomena that seriously degraded the fuel conductivity and would then change accident scenarios that would be good, but I'm not aware of that that being a concern. I believe the conductivity stays pretty good throughout the life of this fuel.

Q: For FL-3 metallic fuel, talking about the fuel cladding chemical interaction problem, there are several ideas like using liners and getters. We have some colleagues that found using the liquid sodium free concept fuel significantly mitigated FCCI. We also found using a dopant additive to stabilize the lanthanide forming compound inside the fuel. Is there any preference among those several concepts?

A: If there truly is a case where eliminating sodium helps eliminate the migration towards the cladding, that's very interesting because in the near term we have a have an emphasis on sodium free fuel. Our

menu of options we have to consider if we could go completely sodium free and realize benefits from it would be great.

Q: Regarding removing sodium, we currently we have no idea whether removing sodium would largely affect this thermal conductivity and also effect the mechanical interaction between fuel and cladding. If we can use any method to prove such effect is not a significant and removing sodium actually can have more benefits or advantage then the disadvantages, would this be helpful?

A: It sounds like good work. If you're eliminating sodium, you're just you're taking away a waste of volume. More fuel can go in it or you have more flowing coolant around the fuel so that that sounds like an improvement in the state-of-the-art or state of knowledge on advanced metal fuels.

Q: A question about the dopant additive. Adding the additive would combine with the lanthanide forming compound which would be one of the measures to mitigate FCCI. At the same time the additive would change some properties of the fuel which is one of the concerns since it could bring some difficulty in getting the license for the metal fuel. Would these concerns mean the dopant additive would not be preferred?

A: Every non-fuel thing in the reactor brings problems and even the fuel brings problems so it's understood at being able to quantify that effect. It's very challenging with the incredible complexity of the of the chemistry in the fuel with all the elements, but it's understood that every engineering solution has a negative aspect. If you could just quantify it to a degree where we know it wouldn't either drastically cause some other undesired effect or reduce the performance of the fuel or the reactor system in some way, it's understood that everything that's not fuel brings a negative consequence, so that's to be expected.

FL-4 – Other Fuels Topics

Q: For FL-4, what kind of particular topics are you interested in? Is concept fuel allowed in this category? We are thinking about nanostructured fuel.

A: For nanostructures please consider the hostile environment that the fuel goes in. There have been nanostructure ideas that would get blown away in the 1st 10 minutes in a core. The other subtopic is in every topic area of NEUP now, that's the idea of allowing creative thoughts out in the universities. Just bear in mind the criteria of relating to mission. By all means, propose some off the wall radical idea that will make us say wow, we never thought of this before as long as it is relevant to our mission.

Topic Area 4- Modeling and Simulation

Q: If a proposed project applies artificial intelligence or machine learning techniques in a minor and supporting way but it's not the primary focus, would it still be relevant under these scopes?

A: Yes

Q: Will it be okay if some experimental validation works are proposed and if so, is there a limit for the fraction? For example, 30% or 50% of the proposed work?

A: Based on the kinds of specifics that we had in previous years, I am not aware of any requirement to that effect as far as a fraction of an experimentation. It is up to the applicant to pick a subtopic area that best fits the work that you are proposing. This one being around capability tool development, but within that I think experimental validation is very useful and even encouraged. If it is something that I'm overseeing on the DOE side, it will involve whatever program office has that other responsibility, reactor development or tools or whatever it is. If it's primarily tool development, I would propose here and validation to some degree is great. If it is more about application of tools and the project is more about the application of tools to an area and experimentation to demonstrate that then it probably belongs in one of the other topic areas.

Q: Is there a website you could point to for the NEUP and SBIR awards on automated meshing?

A: For NEUP last year there was a NEUP project awarded and I can find the project number later, but you can go and look on the neup.inl.gov page under R&D and under NEAMS or Advanced Modeling and Simulation, from 2021. There are project awards and there is an abstract there. On SBIR, there are several projects over two or four years and they are individual. You also can send an email to neup@inl.gov and I'll give you a list of them.

Q: Does this workscope also allow the experimental part? Can we have experiment plus modeling plus simulation all together in a proposal?

A: It's pretty open, the way I described it in the webinar was if the emphasis of what you're proposing is modeling and simulation, a new model development or addition to an existing tool or even a new tool and you want to include some amount of experimentation as part of that, I think that's completely appropriate. If the focus of the of the work is the experimental data for use somewhere else or by someone else, then I think that probably belongs in one of the other topical areas like the reactor or fuels topical areas.

Q: I had in the webinar that we don't have to use NEAMS tools, is that right? If you can use commercial CFD tool to basically develop the model is that really appreciated?

A: The short answer is you're correct. There's no requirement to use the NEAMS tools. It would be helpful for us in the program if you outline exactly what form or format or code or whatever else, the model that you develop, how it would end up in the end so we have an idea of how we could pick that up and use it within the program. It's always good to be precise about the output of your work. But no using NEAMS tools or even DOE tools is not required.

M&S-1 – Multi-scale Modeling

Q: For M&S-1, will predictive framework development for multi-scale be of interest? This is considering tool and capabilities development for coupled systems.

A: In general, yes. This is a very broad statement of work. As was mentioned before, you need to clearly address why any of these other frameworks that exist are inadequate and how this one is going to solve it.

Q: For M&S-1, does the M&S-1 call encourage use of existing NE code suites, the NEAMS suite for that proposal? Or will any validated commercial software be okay?

A: In a word, yes to both. I am happy to involve anyone who proposes work that is relevant to the NEAMS program specifically to whatever degree they're willing. Sometimes we get recipients who propose the work and they've got the funds and they want to go off and do their own thing. That is allowed, but for those who really want to contribute to the work that we're doing within the program and become an integrated part of it, yes. Proposing work on tools that we're using or work where there's a very clear path to improve the tools that we're using would be great. That's very helpful, but this is a broad scope and if folks want to use other tools, it is allowed. I will be, from the NEAMS perspective, looking at whether or not we can incorporate that work and the outcomes from that work.

Q: For M&S-1, would you please provide more specific examples of multi-scale modeling that may be relevant to these work scopes? Should it be multi-scale?

A: The way the scope is currently written, it doesn't appear that it has to be multi-scale. It was more to differentiate from general multi-physics because that was too generic of a term. You know where everyone is going right now trying to make use of more limited data so that you have to do less expensive experiments to validate your tools, your design and demonstrate that you're within safety bounds and criteria. Making use of the knowledge of lower length scale behaviors and how that translates to the engineering scale is where most of the work that I've seen lately has been.

Q: For M&S-1, regarding ongoing work related to this work scope, could you please provide more details on the effort on uranium oxide fuel fragmentation, dislocation and dispersion since any specific effort is not listed on your slide?

A: That is something that I would suggest you reach out for through the NEUP office. There are so many activities like the SciDAC effort on fission gas transport that has something to do with that. There's a major effort within the program on that topic. We're doing things with the Fuel Cycle Program and the ATF program within NE fuel-cycle. We're doing things with EPRI, it's really too much to list.

Q: Is two phase flow reactor safety analysis appropriate for these work scopes?

A: That definitely falls within the M&S-1 subtopic. The one caution, like some of the other things, two phase flow is a problem that if you could solve well and demonstrate that we could model it, particularly water boiling, that would be great. However, it's a high-risk area in that it's often difficult to tell if the work being proposed is going to have an outcome as opposed to just be three years of interesting work. That is an area, again if it's allowed under this topic, that I would be very clear as to what the work scope is and what the metrics for success and any offramps would be.

Q: Question about the possibility of submitting the same proposal to multiple work scopes. For example, can the same proposal be submitted to SN-1 which is a strategic needs work scope in thermal hydraulics and heat transfer and in M&S-1 which is the multi-scale modeling work scope?

A: The CINR overview from Tuesday will be posted on NEUP.gov and I'd encourage you to look through the presentation and listen to the questions that were answered there. The short answer is, no. If there's any additional questions in regard to those requirements or others, please reach out the NEUP Integration Office and NEUP@inl.gov.

I would say if the proposal has to do with development of hydraulic modeling methods and tools capabilities, I think it belongs in this area. The strategic needs is more a blue sky style scope area and may have a little bit different flavor. It's a personal judgement call from the principal investigator.

Q: For MS-1, is it required that the tool and capability should be within or integrated into the NEAMS tools?

A: To repeat some of the above answer, developing the capability in an existing NEAMS code makes it much easier for the NEAMS program and its code users to adopt, but this was not a requirement of the scope as written. As was said probably too often in the webinar, the scope as written is the scope. If you make the case for why the proposal is responsive, important, and impactful, it will receive full consideration. In doing so, the applicant should demonstrate knowledge of existing capabilities in the field and clearly differentiate the proposed work.

Q: If I understand correctly, it is NOT as important that the NEAMS codes be used by the PI as it is that the models developed are useful. However, he also mentioned that it would be challenging to propose developing a new framework, which implies that we are limited to the 3 frameworks listed (i.e., Moose, Vera, and the NEAMS workbench). So, if a PI wanted to demonstrate their proposed new model in a code used by industry that is not in those 3 frameworks, would their proposal not receive the same consideration as using a NEAMS code?

A: There are a couple of things being confused in this question. First, the statement about models being used outside of a specific NEAMS code had to do with the NEAMS Program's own success metric, and not the scope of this NEUP/CINR call. The NEAMS program "aims to develop and deploy predictive computer methods" to address existing capability gaps. Therefore, the program holds that an end user (e.g., industry) employing a model developed by NEAMS in their own code is a success for the program, even if the end user isn't using the NEAMS code(s) instead of its own code(s). The statement regarding existing frameworks was that M&S-1 is focused on developing modeling capabilities and not modeling frameworks. There are a number of existing frameworks and developing new capabilities in one of those frameworks would be within scope. Of course, developing the capability in an existing NEAMS code makes it much easier for the NEAMS program and its code users to adopt, but this was not a requirement of the scope as written. As was said probably too often in the webinar, the scope as written is the scope. If you make the case for why the proposal is responsive, important, and impactful, it will receive full consideration. In doing so, the applicant should demonstrate knowledge of existing capabilities in the field and clearly differentiate the proposed work.

M&S-2 – Verification and Validation/Uncertainty Quantification

Q: For work scope M&S-2, does this call encourage the development of the verification uncertainty quantification process for high fidelity systems? Or is it more about the application of VVUQ for advanced materials such as accident tolerant fuel?

A: It's more the former than the latter. If it's more about a specific application, it will belong more in the topic area related to that application. Whereas if it's more about method or tool development, it would belong here.

Q: For M&S-2, would the software verification and validation work in the IEEE community be considered relevant? Should the proposed methodology be consistent with IEEE standards on Verification and Validation?

A: I think it's up to the applicant and that would be part of your rationale for why the approach that you're taking is so important and beneficial. It has that broader applicability. We have not put any requirement within this work scope.

Q: Does M&S-2 include methodology development?

A: As written, it can. I would be very clear about a specific demonstrable outcome of the proposed work and actually helping to move that area forward and make modeling and simulation tools more useful to the end user. Demonstrate in your application why it's important to do this work and the gap that it fills.

Q: What about extension of methodology development considering artificial intelligence and machine learning application in NE?

A: It's tough whether that should fit here or in the AI/machine learning subtopic under RDO or IC, but I would say if it's specifically aimed at V&V or UQ, this is probably the better place for it. Again, you will need to make it clear as to why it applies to this subtopic.

Q: In M&S-2, to demonstrate the proposed V&V/UQ methodology, is it preferred that we apply it to a new software? One that has not been verified or validated? Or is it okay to apply the methodology to an existing verified and validated software at the application domain as outside the existing validated domain?

A: I need to differentiate between what the NE modeling and simulation program and the NEAMS program is doing and what would be useful to the NEAMS program versus what the scope is. From the NEAMS perspective, I would love to see things that build on the tools that we have already developed or other have developed and are validated, but that's not a requirement under this call. Again, it's broader than that. As long as the applicant demonstrates the gap that they're filling and how the proposed work will move the ball forward and will produce something that's useful to the broader community I think it's fair game under this area.

Q: Can experimental work be included in M&S-2?

A: If it's work aimed at this topic area and has whatever level of experimentation in it, it could be included. Just speak to why this is aimed at development of tools and methods in this area as opposed to the validation or uncertainty quantification on a particular system which would belong probably more under the RDO topics or fuels or something like that.

Q: Scaling is the most challenging aspect of V&V and UQ. Does M&S-2 welcome proposals focusing on scaling analyses?

A: Yes, that's one of the two main areas that I noted would be particularly and directly useful to the NEAMS program and I know to the broader community.

Q: Do we expect the proposal to cover all aspects or most of the aspects or just of narrow to specific physics or specific direction, for example in M&S-2 V and V may be together and UQ is a separate independent topic?

A: We tried to put extremely few constraints. The only real statement we said in either of those M&S-1 or M&S-2 is that last sentence that says that the proposal should demonstrate that you're aware of work that the DOE programs have been doing and what else is going on out there in industry or academia elsewhere? The key is to show that you know what the landscape is and how what you're proposing scratches an itch.

Q: Specific to M&S-2, from the draft to the official release notice there is one sentence inserted about the neural network and it seems to me it's not very relevant to the original scope. Could you clarify why that is inserted here?

A: We are seeing a lot of AI and machine learning out there in proposals in SBIR and Office of Science and NEUP over the year. It starts to seem like that's a magic wand that I just do this thing and the AI or the machine learning or the neural network specifically is going to give us this result. As we were talking within the program, we see significant opportunity in use of those tools, but in applications we see much less recognition of the limitations or the dangers of using those tools without appropriate bounds. The question is, how do you know if you've gone beyond the training space or the validity of the neural network that you've set up or the machine learning algorithm that you've set up? How do you know when you've gone beyond the valid bounds of that. This would be particularly important in a regulatory space. We were seeing where VMV, UQ kinds of proposals have been going. We wanted to highlight that as something across the board that would be interesting to us. All these things are ideas, they're not required for M&S2. These scopes are almost anything goes, just try to pick the best proposed work that that really moves things forward in that technical area.

Q: I have a question regarding M&S-2. In the language of M&S-2 it says that proposal should address the issue of establishing incentive for safety parameters of interest for given technology within framework of regulatory licensing. With a given technology, are we focusing more on advanced reactors, non-light water advanced reactors, SMRs, or the existing fleet, and can you give some example of the safety parameters of interest here?

A: We're not specifying one reactor type or another. The proposal should just be tailored to one or another. The 1st order answer is that the safety parameters of interest are going to depend on the reactor type and the particular component. If we're talking about fuel, maybe it's critical heat flux or like that. If we're talking about a sodium fast reactor it's going to be very different than the important safety parameters for a light water reactor. Make sure you're identifying what the safety parameters of interest should be for that reactor type, and then lay out how what you're proposing would be tackling that.

M&S-3 – Other Modeling and Simulation Topics

Q: A question about M&S-3 or probably in general all of the others categories. Is there budget dedicated to the work scopes under others like M&S-3 or is it like if no good proposal came in M&S-2, we will look at M&S-3? If I have an idea that probably fits well in M&S-3 more than M&S-2 does it make my chances less if I apply to M&S-3 than M&S-2 and vice versa?

A: Anytime a scope area is published there is an estimated budget associated with that. We don't have an FY2023 budget, so there's no accurate determination about how many potential projects in any specific area are going to be funded. But the other area is not seen as lesser or different than any of these other areas, it will be evaluated just like any of these other scope areas and we anticipate that as long as the quality of applications is good that we'll be making selections out of each of the topic areas.

Q: I have a question about the M&S-3 or the general M&S topic area. Are you still interested in the proposal on the integral benchmark evaluations project, for example, for the IRPhEP handbook? In the previous years, we used to have an integral benchmark evaluations work scope, but this year there's not, so do you think a proposal for M&S-3 would be appropriate?

A: If what you're proposing has to do with model development it should go under topic area 4. If what you're proposing has to do with experimental data to support a specific reactor type it probably belongs in a different area. It's never really had a good home but I think it is important work. If it has a modeling and simulation use case I think you could justify there. It would be good to bolster your application with some kind of indication of the impact that that benchmark would make. If you can, fold in statements from an industry party or some other designer. If it's not industry that this particular proposed benchmark is going to be impactful for, we set the requirements at the Nuclear Energy Office top level so you'll need to speak to how it is going to impact deployment of new reactors or continued operation of existing reactors.

Topic Area 5- Instrumentation and Controls

Q: Can detector dead time for multivariate systems be relevant to these I&C work scopes?

A: The answer is yes, but it should be included in a narrative of a specific instrument and a specific application.

Q: Is there any comment on the TRL level of the packaged solution?

A: This is low TRL. We're not expecting a full demonstration in terms of testing in a prototypical environment. There is a progression and a phase. The proposal should clarify how it attempts to provide a demonstration that is adequate to where the product is in terms of technology readiness. There should be a clear identification of what type of demonstration is proposed, in essence, and it doesn't have to be a high TRL type demonstration, which means either relevant condition. As an example, if the proposal targets an advanced reactor that operates at a specific temperature, the sensor and a specific neutron flux, the sensor can be tested for single effect at temperature without neutron flux, but the

materials included in the proposal and proposed work should be able to withstand the temperature. So, it should show the progression and the applicability to the target application to whatever demonstration level fits the researcher, intended purposes, capabilities, and so forth.

Q: Are these work scopes in topic area five more geared to advanced reactors?

A: As far as Advanced Sensors and Instrumentation is concerned, the answer is no. At this point, the call was specifically broad and so it also includes the improvement on the existing fleet solutions. For Cybersecurity, the same is true with the difference really being that for the existing fleet, anything that is proposed has to make sense in the context of what already exists in the existing fleet and there has to be a business case for why they would consider moving to a new solution if one already exists.

Q: Does the involvement of the HBCU and minority serving institutions carry a weightage in this Topic Area 5?

A: The review criteria for all areas of the Research and Development program have a diverse team scoring opportunity, or review, and that does take into consideration any impactful collaborations or involvement of minority serving institutions, which include HBCUs.

Q: What is the best way to get information on the existing technology gaps related to the NE mission?

A: This is a multi-staged approach. The webinar is intended to give you an overview of what those potential gaps are and what's currently going on in the program that are related to these topic areas. There's also several different resources both in the presentations today, as well as on NEUP.gov. All funded NEUP projects since 2009 have abstracts listed out on the NEUP.gov website, where you can use the search function in the top right-hand corner to search for any topic areas or any key words that may come up in those abstracts. Additionally, we are trying to develop additional opportunities for engagement. Those include the concept of having an open engagement, or Office Hours type concept, that will allow applicants to take a look at these topic areas, see these presentations, start to develop ideas, and then have an opportunity to come back and interact directly with the points of contact. Last but not least, if you still feel like you need additional engagement, it would be engaging with the NEUP office so that we can get you in contact with Federal points of contact and make sure your questions are answered.

Q: What is a link for more information on past/current advanced control system R&D?

A: The link with more information about past/current advanced control system R&D can be found on the ASI website: https://asi.inl.gov/#/researchlibrary. It will contain some of the information specifically pertaining to the ASI program, as well as a link to a sensor database, which is a publicly available database of sensors for nuclear application. This is a database which you have to register for (just for identification) and you just have to provide an e-mail. There are no other needs, but if you go through the registration, then you'll be able to see a list of sensors that should be able to provide guidelines or an idea of the scope of work in this space.

Q: We view the distributed real-time sensor capability as being equally relevant to the existing fleet and advanced concepts. Can you comment on any one or both as being a higher priority to DOE?

A: NE values technologies that can support multiple areas such as (1) the existing reactor fleet, (2) advanced concepts, or (3) fuel cycle and material development. Applicants should include in their proposal, descriptions of the technology applicability.

Q: Would you be able to clarify if "relevant conditions" for demonstration must include testing in reactor?

A: For testing in relevant conditions, we encourage applicants to define testing conditions for the technology, and how it compares to anticipated "end-use" conditions. Typically, it would be advisable for applicants to test in the exact reactor environment pertinent to the technology, but we understand that there are practical limitations. As such, applicants should thoroughly explain the methods of testing in, or replicating, relevant reactor conditions. Surrogate testing conditions should be explained and compared to relevant reactor conditions as part of the proposal. Therefore, relevant conditions is not an absolute requirement as part of proposals, but applicants should provide a basis for alternative testing methods.

Q: It was mentioned in the webinar that you are NOT looking for methodology development and application to Integrated Energy Systems (IES). I'm a little confused about this since the flexible operation capabilities are necessary largely because of installation of the coupled energy systems. If IES is out of the context, then my assumption is that the requirement about the load following capability is more in the context of the load balancing among multiple units. In other words, the load-follow operation here aims to satisfy the demand change in grid and balance between units, rather than the output variation of another unit in the coupled system (e.g., industrial heat generation). Is this the case?

A: When it comes to integrated energy systems (IES) technologies and methodologies, applicants should review the FY23 CINR work scope RDO-3: Integrated Energy Systems and Industrial Applications, to determine for which solicitation their proposal is best suited.

IC-1 – Sensors and Instrumentation

Q: For IC-1, can you provide any specifics on detector requirements? For example, neutron or gamma rays or charged particle detectors?

A: I think the proposal should identify the specific targeted application. The application needs to support the Office of Nuclear Energy, so the more relevant considered topics would relate to neutron flux. Other charged particles are probably not of interest, although it's up to the proposer to make the case that it would be. There is some work related to using other types of particle detectors to control a nuclear reactor, but again, it's important that you make that tie, not the development of detectors itself, rather how it is intended to be used to support the Office of Nuclear Energy office mission. The short answer is neutron gamma flux are of relevance in conditions that are then specific to either the existing reactors or that they're specific to the design of advanced reactors. Normally, the main difference there is related to the temperature at which they are intended to operate.

Q: Is IC-1 interested in the development of new detector materials?

A: It is, but not in and of itself. We're interested in collecting a full solution for an instrumentation need and working towards filling a gap in existing technology. The work that we are seeking should be innovative work in nature and the development of a new sensor type that depends on a new material would be extremely interesting.

Q: In IC-1, is the application of Artificial Intelligence / Machine Learning concepts to radiation detection data analysis relevant?

A: Yes, this is relevant both to IC-1 and IC-2. Since we are strongly target and apply, we want a targeted application to be considered and to be clearly stated. Radiation detection is important to reactor controls and the application of machine learning and artificial intelligence can be considered or could be included in topics of interest both from the standpoint of improving the performance of the existing detectors, or from the standpoint of providing new methods for controls. So, in this case, we are seeking proposals that demonstrate an I&C need, not demonstrate solely the application of machine learning or the development of machine learning or artificial intelligence algorithm. If you do package and provide a narrative of how the machine learning or artificial intelligence would be used to enhance the performance of the sensor and to which application is targeted, then, yes, they are an interesting piece of the work that can be proposed.

Q: In IC-1, is the study of radiation effects in advance semiconductors relevant, and what about studies that focus more on the device level issues? Are those also relevant?

A: Radiation hardened electronics is part of the development of instrumentation. This is another situation where this specific aspect has to be put into context. There are instruments that do require electronics to be close to the source of radiation. In this instance, the development of radiation hardened electronics is an important component, in order to demonstrate or to define the performance of the instrument. In this case, the effect of radiation on the electronics is an important piece. However, we are not seeking material development type solutions, where the topic itself is addressed as a standalone topic. It needs to be included in the narrative for the development of an instrument that closes the gap on existing technology or improves the performance of the instrumentation. Then it needs to be tied back to the application, identifying where such radiation hardened electronics, or component for electronics, should be developed.

Q: In IC-1, are sensor power issues relevant?

A: Yes, this is an important piece for performance, both in terms of noise and in terms of heat. Ideally, an improved sensor performance could be that you don’t have to power a sensor, so that it can be self-powered. There's a lot of concepts in the sense that could provide power to the sensor without having to feed it through cables.

Q: In IC-1 and IC-4, what is the technology readiness level we should target?

A: The nature of this request for proposals is to target innovative work. I don’t want to provide specific numbers in terms of technology readiness level, but we are looking at innovative work and providing feasibility demonstration and providing an initial single effect that you want to demonstrate. In essence, we are targeting a low TRL, although the definition of the TRL state can be a rather long conversation, so I'd say low TRL as being the answer.

Q: Do you believe structural health monitoring to be as relevant in this call?

A: For clarification, the IC-1 work scope is designed to be “application agnostic”, as it is intended to allow for a wide variety of sensor types, and methods of use to be applicable. For instance, our prior year work scope focused specifically on sensors that supported structural health monitoring. For the FY23 CINR solicitation, the IC-1 work scope is no longer limited to sensors only applicable to structural health monitoring, provided that the technology supports the U.S. DOE Office of Nuclear Energy mission and focuses on one of the following areas: (1) the existing reactor fleet, (2) advanced concepts, or (3) fuel cycle and material development.

Q: Composition measurement in radioactive molten salts is critical for MSRs but is not well developed. Multiple candidates can be used to tackle this issue: reference potential measurement, laser-based techniques (LIBS), or hydrodynamic electrochemical techniques. I am aware of the multi-sensor array work but would like to potentially improve on that. Would this type of work be of interest to your program?

A: As part of the IC-1 work scope, sensors and instrumentation technologies applicable to Molten Salt Reactors (MSR) are considered relevant, provided that the technology supports the U.S. DOE Office of Nuclear Energy mission and focuses on one of the following areas: (1) the existing reactor fleet, (2) advanced concepts, or (3) fuel cycle and material development. I would advise all prospective applicants to review the other FY23 CINR work scopes to ensure they are submitting proposals to the most relevant solicitation.

Q: Would a portable sensor for material qualification of molten salts using electric discharges with fiber-optic coupling fit the work scope?

A: As part of the IC-1 work scope, sensors and instrumentation technologies applicable to Molten Salt Reactors (MSR) are considered relevant, provided that the technology supports the U.S. DOE Office of Nuclear Energy mission and focuses on one of the following areas: (1) the existing reactor fleet, (2) advanced concepts, or (3) fuel cycle and material development. I would advise all prospective applicants to review the other FY23 CINR work scopes to ensure they are submitting proposals to the most relevant solicitation.

IC-2 – Advanced Control Systems

Q: For IC-2, does the coupling with digital twin asset imply the use of INL or other specific products or does it just mean the use of simulation technology is encouraged?

A: Definitely, the latter. There's no specific relation to any INL developed product or any other laboratory in this sense. It's the broadest term of digital twin.

Q: The ultimate goal of the work scope is to enable semi-autonomous operations. It is not clear to me whether the focus should be placed on the single-unit (load following) operation or multi-unit (load balancing) operation, or both. Could you clarify?

A: For clarification, the IC-2 work scope focuses on many different aspects of advanced control systems including, but not limited to, loading following and load balancing operations. NE is interested in receiving proposals which can support one or both of these aspects.

Q: Question regarding IC-2, this may just be my misunderstanding from the webinar, but I had the impression that this scope is not seeking proposals related to the integrated energy systems, could you clarify that?

A: As far as Integrated Energy Systems there are other subtopics that are a little bit more targeted towards those and might be beneficial to review. LS2 looks at the safety implications of utilizing process heat, also RDO-3 is the integrated energy systems and industrial applications scope. It comes down to, if the control system that you're proposing developing or researching is specifically targeted to integrated energy systems, then it may be beneficial to apply to that RDO-3 scope. If it's something broad and cross-cutting and advanced control systems that can apply to many different avenues, maybe it's not just about balancing thermal energy systems or integrated energy systems, but also load following or balancing multi-unit plants then that might be something more beneficial to be under IC-2. It's up to the discretion of the applicant but this year the process when applicants submit the proposal is that it will be reviewed by the program managers for relevancy and there will be the opportunity to move it to a more appropriate work scope that the program manager sees as a better fit.

Q: A question about the relevance when it comes to autonomous control with AI/ML, would a better target area be IC-2 or RDO-5?

A: RDO-5 is better at capturing artificial intelligence and machine learning applications that are more application agnostic in the sense that they are techniques that could be applicable to multiple different avenues and cross-cutting in nature. Whereas if you were developing or utilizing AI/ML techniques to develop autonomous operations for example then that is clearly targeting an advanced control system application. In that case it would be more beneficial to apply towards IC-2 because you have an application in mind versus RDO-5 where you're developing general AI/ML techniques that could be used for various different applications.

IC-3 – Advanced Nuclear Cybersecurity

Q: Would technical solutions to cybersecurity challenges associated with the human operator and how they can identify, avoid, or mitigate a cyber-threat be suitable for this topic area?

A: Yes, so long as the proposed work scope is specific to current and/or future nuclear application(s) and demonstrates awareness of, and some specific envisioned advancement over, existing commercial tools and past or ongoing research.

IC-4 – Other I&C Topics

Topic Area 6- Licensing and Safety

Q: If we focus on methodology enhanced for EMDAP or PCMM, methodology development in particular, like knowledgebase management for evidence collection, organization and enhancement. In context of value of information for assimilation of heterogenous evidence related to VVUQ. Will it be welcomed in this technical area?

A: We're not looking for a methodology we're looking for more of a design under LS-2 or more the actual results than methodology. We would rather have a case executed rather than just a methodology proposed. VVUQ uncertainty quantifications probably more applies to the LS-3 pr LS-4 advanced reactor topics. We're not looking so much in LS-1 in terms of validation, for example.

LS-1 – Risk Informed Systems Analysis/Probabilistic Risk Assessment

Q: Would educational activities under work force training fit underneath the LS-1 work-scope?

A: That's a good question, we hadn't considered that type of activity. My initial response would be no and that this would be more focused on improving the usability of the models. I suppose a similar focus area would be the output of the models would fall under workforce training, but my initial response would be probably not. We are not interested in training purposes in this scope.

Q: Do you expect a probabilistic risk assessment software for this scope or is it expecting improvement to existing PRA software such as sapphire?

A: It could be both, we are mainly looking for improvement to existing tools rather than developing new tools or software. However, if you propose a new tool that is significantly better than sapphire or other tools that are currently available then that would be a possibility.

Q: Do you expect a PRA software as a deliverable for LS-1? Or are you expecting improvements to existing PRA software like SAPHIRE?

A: A novel PRA software is a potential deliverable, but not a requirement for proposal acceptance. Our interest is in any methodology or techniques that advance PRA so that it can be applied to a broader set of applications. If the proposal includes improvements to PRA software, like SAPHIRE, and accomplishes that goal, they will be considered. In other words, yes, development of innovative PRA methodologies are considered reasonable work scope without the delivery of PRA software.

LS-2 – Safety Implications of Utilizing Process Heat

Q: Is thermal electric energy harvesting technology is relevant to work-scope LS-2?

A: Initial inclination is no, as those devices tend to be low efficiency. We are looking at directly using thermal energy from the reactor in this topic. When referring to thermo-electric devices, as in a generator and turbine combination, we are looking at the safety implications of pulling heat off of a turbine, and that would be within the scope.

LS-3 – Advanced Reactors and Fuel Cycle Facilities Materials, Accountancy, Control, and Physical Protection

Q: Any additional thoughts on detectors for ARS?

A: We are interested in anything related to improving MCNA for improving advanced reactors, the main thing is where there are specific cases of advanced reactors where we would need to do measurements for quantifying actinides. Burnup measurements for pebble bed reactors and measurements of molten salts for molten salts reactors, any technology that makes it faster, better, cheaper as well as improves measurements certainty there would be interest there.

Q: Is radiation detector development relevant to this work-scope?

A: For fuel cycle facilities, if it's personnel monitoring, no it is not. If it is going to be used for any kind of nuclear materials controlling accountancy requirements, then yes.

Q: A follow up to the previous question, what types of radiation detectors might be most relevant?

A: As far as radiation detectors are concerned, we are interested in gamma spectroscopy and alpha spectroscopy we are interested in neutron coincidence and multiplicity and the traditional workhorses for accountancy type detectors. Beyond the traditional approaches we are also interested in detectors that can operate in extended harsh environments such as Argonne hot cells, or high radiation environments where radiation is greater than 1000 R per hour. In that case we would be interested in relaxing some of the spectroscopy requirements or going to low resolution as long as in your proposal process you explain how this could be used for nuclear material control and accountancy purposes. For example, if we are trying to track material in a hot cell something like a gamma camera or the ability to track the movement of nuclear materials throughout the hot cell and make the movement step operational would all be things we are interested in.

LS-4 – Advanced Reactor Licensing Topics

Q: For LS-4, the description of this call is a bit broad but I would like to confirm, is modeling and simulation responsive to this or is it more experimental? Is it more an advanced reactor specifically or if we need to, can we apply it to light-water reactors for example and see how this can be useful for advanced reactors.

A: It's purposely written to be very broad. That gives you the opportunity to propose activities that you think could help reduce the regulatory risk for advanced reactors. To answer one of your questions, it is specific to advanced reactors, but that applies to both light water SMRs as well as the non light-water reactor concepts. The current fleet would not apply, but SMRs or MSRs, HTGRs, microreactors, molten salt reactors would be applicable. We're hoping that we can spark some innovative ideas. As long as you can show a tie that your activities are helping to reduce the regulatory risk by helping to address technical questions that could come up in the licensing process, then that would be considered to be responsive.

Q: How do we decide in which work scope a proposal might fit? For example, if we propose a new technique that can highly enrich the quantity and quality of the database for advanced reactors, shall we apply for RDO-6 or LS-4.

A: Work scopes are purposely written very broadly to encourage innovative ideas. Hence, in some instances, proposed activities could potentially be relevant to more than one work scope. In these cases, it is recommended that the applicant submit the proposal to the work scope which is most relevant. LS-4 is focused on activities that can reduce the regulatory risks for advanced reactors. In some instances, establishing a database or addressing technical questions, will reduce regulatory risk. RDO-1 is focused on reducing technical risks for advanced reactors. It’s up to the applicant to determine whether their proposed activities better support regulatory risk reduction or technical risk reduction. Alternatively, an applicant can submit a proposal to RDO-6, if proposed activities support reactor development and plant optimization but do not fit under other work scopes.

LS-5 – Other Licensing and Safety Topics

Q: I have noticed a gap in MSR developers' understanding when it comes to salt radiolysis. After speaking to researchers from TerraPower and Kairos at the ANS annual meeting, it seems that this may still a blind spot for them. Would this type of work be of interest to your program?

A: Thank you for your interest in supporting advanced reactor licensing. Radiolysis may create some radiolysis by-products that could affect the chemistry of molten salts. This is a field that has not been extensively explored to date. Experiments have been performed on fluoride systems but nothing has been done on chloride systems. Pending review of the proposal details, this research could potentially support the Office of Nuclear Energy mission since we have very limited data in this area for both fluoride and chloride systems, and we do not know if and how the thermophysical and thermochemical properties of molten salts will change based on radiolysis by-products.

Topic Area 7- Advanced Nuclear Materials

Q: For proposals focused more on the computational side, can they integrate advanced predictive machine learning methods for machine learning purposes? Would that be acceptable or relevant?

A: Certainly, whatever you have at your disposal to answer the question and increase the knowledge of these material issues would be excellent.

Q: Is rock salt among the materials that may be relevant to these work scopes?

A: Those would not be of interest in this particular topic.

Q: Are waste form materials of cesium and strontium relevant to these work scopes in topic area 7?

A: NM-5 is strictly looking at krypton and iodine. This is of interest to the general fuel cycle topic area and you are welcome to submit those types of topics in the "other" topical area.

Q: I wanted to ask a follow up question to the question about the irradiation effects. I looked through the NSUF library of materials and I couldn't identify geometries that would work for specific experiments. So, for the NM work scope, how would it work if we would like to get access for NSUF facilities? This year they seem to be either CINR R&D or an SF access only.

A: From a functional standpoint, the intention for decoupling those is to allow a project to be awarded, for example, in this FY23 cycle and then in subsequent cycles to apply for specific NSUF access. It would be beneficial for you to reach out to the NSUF office if you have curiosities about how their process steps work and how they know what's available in the library and other things like that from a specific standpoint. But from a general standpoint, they're decoupled to allow any awarded project to make an NSF access only application in subsequent years while the project is ongoing.

NM-1 – LWR Core or Structural Materials

Q: For NM-1, will radiation damage be considered as part of the environment that assists fatigue?

A: For this topic, environmental assisted fatigue, I think traditionally speaking irradiation is not considered.

Q: What are the specific material types that would be relevant for work scope NM-1?

A: This would be the low alloy steels, the stainless steels, and their weldments. Since the reactors are not all the same there is some variety in the materials and that's why we did not specify an alloy.

Q: For NM-1, is fatigue or fretting phenomenon of zirconium cladding relevant?

A: No, that would be more of a fuels issue, so this would be not within the core.

Q: For NM-1 and NM-2, do these work scopes seek computational projects or experimental projects?

A: What we usually see is a combination of the two. We are not prescribing one way or the other but in general we do usually see a mixture of the two.

Q: For NM-1, is there any interest in environmentally assisted fatigue of prior irradiated materials?

A: This particular subtopic, NM-1, the focus of the call is addressing the uncertainty and overestimation of the current NUREG CR-6909 as well as the ASME Section 3 Subdivision MB, we are not particularly focusing on the irradiation effect.

Q: For NM-1 and NM-2, is environmental exposure and testing as well as design for property improvement of relevant structural materials of interest or relevant to those work scopes?

A: For both topics the information that we gather and the better that we understand these materials, the better we can use them for materials discovery and design, however material discovery is not the focus for NM-1 and NM-2 although the information could eventually be used for that. In terms of NM-2 we're interested in the creep damage mechanisms and fatigue damage mechanisms and their interactions. Interaction damage mechanisms is one of the keys, currently our state of knowledge is that we essentially determine the performance of existing materials or try to design new alloys by brute force mechanical property testing because there is really no understanding in terms of what are the underlying mechanisms that alloy developers can exploit in order to develop the materials that will have balanced properties. We're looking for innovations and help in that particular area so we can improve our efficiency in terms of establishing this pipeline of qualified materials. Right now, the current approach of brute force testing is very resource and time intensive. Creep fatigue is a very difficult phenomena that is both at the local microstructural level as well as in the structural level.

Q: For NM-1 and NM-2, does the discovery of new structural materials that focus on the characterization of microstructure and thermal properties at elevated temperatures fall within the NM-1 and NM-2 work scopes?

A: For NM-2 it's a little bit outside, if we have structural materials that indeed perform as what we would like to have for high temperature reactors subjected to thermal transience that we see in the high temperature reactors that would be great but obviously we would really like to have the understanding of the mechanisms so that we can take advantage and leverage this information to avoid time consuming and resource intensive mechanical property testing. If whatever is proposed can address that for NM-2 it is within the scope but we like to be able to apply that for not just one single material but for the entire material class so we can leverage that in addressing the pipeline of materials. We would like to have as many qualified materials as we can so the advanced reactor designers can take advantage of those wider design windows. Right now, they are limited by the number of available qualified materials so it really constrains reactor design. For NM-1, the call is to address the structural materials for the current LWR fleet so the materials aiming for higher temperature applications as well as the associated damage microstructural mechanism does not fall within the core of this topic. I'd like to emphasize that this topic has a long history, the very first fatigue testing started in the 1960's so there is a lot of results data in this area, but as we are aiming for operating the reactors in longer term there are some new issues that we need to address.

Q: For NM-1 and NM-2, is non-destructive detection of fatigue and creep damage relevant to either of these work scopes?

A: For NM-2 I would imagine that that is one of the suite of characterization tools that will help us to understand the underlying mechanisms. For NM-1 I concur, the non-destructive evaluation is one type of characterization tool. If it can reveal the insight between the reactor and the environmental assisted fatigue damage and address the current uncertainty in overestimation of the existing models it should not be excluded in the proposal but if you're proposing that tech you need to provide a convincing case.

Q: For NM-1 and NM-2, are specific material fabrication approaches relevant?

A: For NM-2, we consider that to be the traditional application process, whether you make forgings, plates, pipes, tubings, or fittings using any sorts of metal practices in fabrication, we look at that as all raw product forms, so we are not investing in developing those fabrication process. All of those fabrication processes are considered to be available fabrication process for structural applications, so we are focusing on the materials aspects, creep damage mechanisms, fatigue damage mechanisms and their interactions. For NM-1, the focus is not any particular material fabrication technique because we are looking into the environmental assisted fatigue damage mechanisms for materials that are currently in use in the existing LWR fleet. If you look at the type of materials mentioned, you will find that the right manufacturing processes probably are the traditional ones. You'd look into how the environmentally assisted fatigue applies to these materials and how your studies can better understand the damage mechanism.

Q: Are high entropy metallic structural materials relevant to either NM-1 or NM-2?

A: No, they would be outside the scope for those two topics, however they are of interest in general to the NE mission for future materials so I would look at the "other" category for high-entropy alloys.

Q: My question is about NM-1, is reinforced concrete degradation of interest for this call?

A: for NM-1 in particular, no, the focus is more on structural materials. If you have interest in concrete and have something you'd like to look at that still meets our mission. The other category is certainly available if you'd like to propose in the concrete area.

Q: For NM1, is there a specific material of interest in that scope?

A: No, not a specific one but we do want it to focus on the materials that are typically used in LWR. As I'm sure you well know there are several different types across the different reactor types. In the light water reactors domain, including pressurized water reactor and volume water reactor those materials that have been investigated for environmental assisted fatigue historically include low alloy steels, stainless steels as well as the weldment between the two. There are few studies also focused only on nickel alloys, but nickel was more resistant to environmental assistive fatigue then the other alloy combinations that I have I just mentioned. We didn't want to pin it down to any particular materials, instead we wanted to give the university community a lot more freedom to pick the ones that you think make the most sense in this area.

NM-2 – Advanced Reactor Core or Structural Materials

Q: For NM-2, are materials for fusion reactors considered relevant to NM-2?

A: Fusion is outside of the nuclear energy mission. There is some overlap and interest in materials between the fusion program and the fission program which is what this work scope is focused on, but for materials only for fusion that's outside of the scope.

Q: In the slide for ongoing work that is relevant for work scope NM-2, alloy 617, alloy 709, and grade 92 are listed. Does that mean that those alloys are preferred because they complement ongoing work or is it better to avoid those alloys to avoid being redundant?

A: Of the material classes, we highlight the stainless steels, the nickel alloys, as well as the ferritic martensitic steels that are applicable for different types of structural components for fission reactors. Out of that we are saying that we can only assess these existing materials in terms of the creep fatigue damage failure mode by brute force mechanical property testing and we would like to get help from the community to look at that from a more fundamental aspect to understand the mechanisms. If there's other nickel-based alloys then we would like to use it, but in order to understand whether it can sustain the type of creep fatigue loading for fission reactors, for high temperature reactors currently, we can only do mechanical testing properties. But the scope of NM-2 is to look at more fundamentals and avoid the mechanical properties testing. If one wants to study alloy 617 as a surrogate to understand the underlying creep mechanisms, fatigue damage mechanisms and creep fatigue interactions that would be okay. There won't be overlap in terms of studying those mechanisms that would allow us to generalize that to the entire nickel base class or the stainless steels or the ferritic martensitic steels.

Q: For NM-2, does the structural materials spectrum also cover cladding materials and accident tolerant fuel clad options?

A: No, for structural cladding but not for fuel cladding. My distinction for structural cladding, drawing an analogy to the light water reactor fleet, the alloy pressure vessel steel will be cladded structurally by stainless steel in the reactor pressure vessel so it will be structural cladding material. On the other hand, if you have fuel pins and fuel cladding for the fuel, those are not within the scope.

Q: For NM-2, will the effects of radiation damage on creep and creep fatigue be considered important?

A: It is considered important in the following sense, that a lot of the structural materials we are looking at in the secondary will not see a radiation dose, but those components that are closer to the core like the reactor vessel will see some fluence. Irradiation could cause some irradiation creep in the act with some cyclic loading but I would look at the order of the magnitudes. First things first, we don't have an understanding of the high temperature cycling and stress effect in terms of this, so if you can do everything all at once yes, but if not then we'll address the high temperature stress part since the irradiation dose of our structural materials are not very high.

Q: Just to clarify one more time, fuel cladding materials are not considered structural for this topic?

A: Fuel cladding is not considered to be part of NM-2.

Q: For NM-2, is fatigue of Chromium cladding and Silicone Carbide CMC relevant?

A: Silicon Carbide CMC is not. In our slides we had topics that are considered to be out of scope for NM-2, composites are out of scope. There are other places that look at that, we are looking at metallic components for structural applications like vessels, piping, that type of structural component in high temperature reactors.

Q: For NM-2, are joining techniques of relevant structural materials relevant?

A: A weld is part of the structural component so therefore the underlying fatigue and creep fatigue mechanisms of weldments we would have interest in. For base metal and weldments, the understanding of the underlying damage mechanisms is what we need to close knowledge gaps and take advantage of those understandings through this type of work, so we can be more efficient in terms of modifying materials rather than by brute force mechanical property testing.

Q: Are coatings considered composite materials and therefore not relevant to the NM-2 work scope?

A: Coating in the general sense I don't consider to be a composite, but if the coating by itself is some sort of metal instead of ceramics we would like to understand the same type of failure mechanisms. Our basic emphasis is more on the structural materials, how you make piping, those type of things. We really want to look at structural materials, how we can improve our understanding and leverage that so that we can qualify more structural materials for fission reactor applications. Coatings and claddings could be included under the "other" category, NM-5. Those are of interest in general to the NE mission for advanced reactors that have particularly corrosive environments.

Q: For NM-2, is coolant environmental effect a relevant topic for creep fatigue work in this work scope?

A: To the extent that it effects the fatigue damage mechanisms and the creep damage mechanisms and their interaction.

Q: Would advanced-manufactured materials be a focus for NM-2?

A: The focus of NM-2 is on wrought product forms, not AM.

Q: For NM-2, if we propose some mechanical testing, creep fatigue, can we just do a fairly limited amount of mechanical testing and focus more on characterization and modeling to tell the mechanism? I think this could be the purpose of this call. But if we need some material that's already been tested, can we access this material from the program for free? If we need some material that's already been tested but in specific environments at higher temperatures, can we use that material?

A: We do have the NSUF materials library that has a lot of materials that have been tested in the past. There are irradiated materials in there as well. You can look there and see if what you need is in there. The challenge that confronts us is that, given a structural material that looks to be very promising under some of those environmental conditions like the fast reactors or gas-cooled reactors or molten salt reactors, we can only determine whether or not it has sufficient creep fatigue resistance by actually doing a lot of testing. The scope of this call is to have you guys come up with great ideas to allow us to have some understanding of the mechanisms whereby we don't have to do a lot of testing or even as a screening criteria so that we can screen out some that are not as promising so that we don't need to go brute force and spend a lot of money to do creep fatigue testing. If we can, with your help, come up with this type of understanding, it will really help us to solve and enlarge this structural materials

pipeline that will allow us to so bring in more materials for consideration. In terms of material supply, we are not looking at any specific materials. We can look at classes of materials in the base program, we do have the creep fatigue testing done on some structural materials like alloy 617, alloy 709, whereby we might be able to provide researchers some of those tested materials that have been subjected to either creep or creep fatigue history that you might be able to look at the characterization and figure out what is going on.

Q: There's a purpose for high temperature creep fatigue test, for something like high temperature gas reactors. But if we propose something with molten salt environments as the temperature is low, would that be interesting for this topic area?

A: We purposely didn't identify which reactor environment, so it is open to any of the reactor environments. Creep fatigue is an issue across the board, so having a better understanding of what's going on, whether it be MSR or the high temperature reactor still is necessary.

Q: If we can do everything in one shot, maybe it's good, but I think it could be too complicated. I think there's some value if we include environments effects, for example, for molten salt reactors if we add occlusion and creep fatigue together. Do you think this is something that would be interesting for the scope?

A: I will say more bang for the buck. We love it. The more that you do with the same amount of funding the better.

Q: I had a question about NM-2, the FOA mentions damage mechanisms for creep fatigue. Are you also looking for fatigue only or creep only damage mechanisms or does it have to be creep fatigue?

A: Our focus is on creep fatigue. The fatigue interaction occurs at a larger structural scale length scale, so some of concepts in the 70s thought about surface crack initiator from the surface of a component and cavitations on the grain boundary interior, how the tools of a get together to interact, there's some models like that. To understand creep fatigue interaction the understanding of these separated effects like creep by itself and fatigue will be quite helpful.

Q: If you want to propose something in line with additive manufacturing of a structural materials, should we go for NM-2 or NM-3? Which one is going to better fit this scope?

A: If you're looking at the manufacturing standpoint, it's probably NM-3. If you're going use that as the model for determining mechanistic properties, and especially in the creep fatigue area, probably fit more under NM-2. NM-2 isn't specifically looking at fabrication, it's mainly just looking at the mechanisms of creep fatigue. Of course, how it's fabricated has an effect on the mechanical behaviors of the materials, but if your focus is really just on fabrication then it would not be within the scope of NM-2.

Q: As a follow-up, if it would be using additive manufacturing to overcome certain structural limitations of the current materials, would it be so more NM-3 then?

A: Yes, that would be in NM-3.

Q: For NM-2, is there any interest in the environmental effects under irradiation or is it only at high temperatures using creep fatigue evaluation and identifying the behavior?

A: We're always looking for more bang for the buck, so if you want to add one more issue of corrosion, go right ahead. Creep fatigue was our focus but if you want to add one more variable, you're very welcome to do that.

Q: I have follow up question on NM-2. Our question is, is radiation damage a factor or should we only consider the creep fatigue behaviors? We know those high temperature alloys will be used, and although they are relatively far away from the reactor core, there may be some radiation damage there. Should we consider these effects when we study the creep fatigue phenomena should we focus more on the pure mechanical effects?

A: If you want to add that factor in, I think it would be OK. In the actual operating reactors structural components, we'll see solve temperatures, stress, and some radiation dose depending on the components and corrosion effects. All of this will influence the structural failure both in terms of creep fatigue, and the way that we think about that is that we do it step by step to establish the basic mechanisms under temperature and stress in terms of creep fatigue and then ask what will be the additional effect. How would the creep fatigue cyclic life be reduced further if you have neutron irradiation and you have corrosion due to cooling? If there's a general corrosion where you just lose materials, those are easy to take care of. The concern is that if there are mass transfer effects that will reduce or change your material where, for example, some of the chrome might be into the molten salt coolant, those are there additional effects of the basic fatigue damage under stress and temperature. If you can add the irradiation on top of the of the temperature and stress that would be great, but I don't see the how you can just do your radiation without understanding the basics of stress and temperature.

Q: Would wrought 316H and 304S be appropriate materials for the CINR Topic 7 NM-2 work scope?

A: In NM-2, we are seeking the understanding of the underlying mechanisms of creep, fatigue and creep-fatigue interaction for structural alloys, and the use of such basis to assess existing material systems or to design new material systems to provide an overall optimum resistance against these structural failure modes, without relying solely on extensive mechanical properties testing. We are interested in austenitic stainless steels, ferritic-martensitic steels and nickel alloys, all in wrought product forms. Since wrought 316H and 304H belong to the austenitic stainless steel class, they would be within the scope of Topic 7, NM-2.

NM-3 – Advanced Manufacturing Technologies

Q: Are 3D-printed structural alloys relevant?

A: I think that would probably be more in the NM-3 sub-topic. We are looking at essentially the raw product forms, the more traditional application route to support near term deployment. NM-3 is advanced manufacturing technology but certainly also interested in the material made by advanced manufacturing technology including the environmental effects in reactors.

Q: For NM3, could you please give an example on the application of machine learning and artificial intelligence for NM-3?

A: Machine learning and artificial intelligence have a very important role in the area of developing manufacturing technology and also supporting the manufacturing technology process. There are lots of applications that can take advantage of machine learning and artificial intelligence. Any innovative ideas are welcome for this subtopic area.

Q: For NM-3, would a proposal on high throughput characterization techniques along the lines of a development and its application to fundamentally understand the deformation mechanisms of advanced manufactured materials be a relevant idea?

A: NM-3 does include emerging capability that can help manufacturing technology development. If the proposal can demonstrate how this high throughput testing technique can help material development or qualification of manufacturing technology that's certainly of interest.

Q: Are laser based additive manufacturing technologies relevant to NM-3?

A: NM-3 is about advanced manufacturing technology, which refers to technology that has not been broadly used in the nuclear space. If that manufacturing technology can have a broad application in the nuclear industry, it would be of interest.

Q: Would advanced approaches for metal heat treatment be relevant to NM-3?

A: NM-3 does cover the processing technique, so if there is innovative technology development that can help the processing technology that is of interest.

Q: Does NM-3 need to be focused on structural materials only?

A: No, this is advanced manufacturing technology not limited to any structural component or cladding so there's no requirement on that.

Q: Would transformative processing and fabrication approaches for both light water reactors and advanced reactors be relevant to NM-3?

A: Yes.

Q: Would advanced fabrication methods for cladding materials be relevant to NM-3?

A: Yes

Q: Is advanced manufacturing of Silicone Carbide CMC cladding relevant to NM-3?

A: We don't have specific requirement on a particular material or a particular structure so, yes, the interest is advanced manufacturing technology for nuclear energy applications.

Q: Since advanced manufacturing technology of cladding materials may be relevant to both NM-3 and FL-3, are there any insights you can provide to guide us to submitting in the right topic area?

A: In terms of NM-3 we are focusing on advanced manufacturing technology not specific to any application or structure. For FL-3, any fuel concept has to have manufacturability and economics involved. It's one thing to use additive manufacturing to make a very specialized, unique bracket in the reactor, but cladding in general we have a lot of tubes, a lot of material, and a lot of throughput, especially once they're in reactors. If you're going to address cladding manufacturing it better have high

production rate and have the possibility of economical production, otherwise the normal tubing extrusion type processes would beat it out. That's the only consideration, it's one thing to do a specialized part, it's another to do high volumes of fuel cladding.

Q: For NM-3, I guess my question is in that scope, is there an interest in additive manufacturing of metals and specifically process monitoring of that to enhance capabilities for qualification of materials?

A: Yes, as broad as this area is, absolutely those are going to be critical to qualification and also consistency in making the material over time.

Q: As a follow-on to that within the advanced manufacturing technologies and NM-3 category, the fabrication is a big part of it, but the processing is the focus. Is there also room for a properties type of measurement in there or do you really want to focus just on the processing itself? Is there any emphasis on moving towards property or characterization measurement in that particular category?

A: Yes, one of the things that we looked at for advanced manufacturing is the ability to determine what the properties are of your constructed component, subcomponent, or system. The more that those are integrated with the fabrication processing and how we can leverage those is going to be important to the future.

Q: A follow up question on that. Is the focus more on basic research or more toward the applied. What would be the TRL level for the funding opportunity? Also, is there any particular interest in using any of the DOE libraries or software or codes that have been already developed?

A: In this area it's OK to be doing basic research, but we also want you to be considering what the end application is going to be, where it's going to fit in so that you're communicating with a potential end user and getting feedback for that system as you go through your efforts. It can just be in a small way, but that's important to make sure that you're understanding manufacturing needs or capabilities when you go to an industrial application in the end. Using the DOE codes and standards and all that is great, if it benefits your effort, go for it. There isn't any special consideration if you leverage those efforts just do what you need to be successful in your application.

Q: For NM-3 I'm also interested to hear if the program is interested in a combination of modeling and experiments to understand the mechanism, such as some simulation tools to help for the predictions of creep fatigue behavior.

A: We would expect modeling to be a big portion of the proposal, since we're looking to try to understand what the mechanisms are. If you need a modeling looking at some of the atomistic simulation, to understand how dislocation interacts with some of the cavitations, by all means, the goal is to have an understanding of the creep fatigue. That can be via a characterization via software, some of those simulations to know the end result. You guys are the experts to figure out what you do, whether you do characterization, what type of characterization and what type of modeling effort. We're looking for help.

Q: In the CNR workscope Q&A, oxide dispersion strengthened materials were brought up in the workscope of FL-3. Is there are also interest in addressing their microstructure preservation under the conditions of welding or advanced manufacturing under the NM-3 work scope.

A: Yes, preservation of a properties during welding and advanced manufacturing materials is of interest in that area as well. It's another important area that that has to be resolved.

Q: For NM-3, is there more interest in materials development or more of a characterization of the process structure property relationships or any of those links using advanced manufacturing?

A: In this area it's all the above. We know that that there's capabilities out there that we're trying to learn more about when it comes to advanced manufacturing and of course, there's the relationship between the process and your materials and then correlating those as we go to qualification, so it's actually both of them that we're interested in.

Q: For NM-3, are you interested in the coating technology for the colliding tube to improve the performance for the fast reactors?

A: Yes, we would be interested in that as well.

Q: As a follow-up, I was wondering if for this kind of performance testing, does program expect a very high radiation dose or some extreme environments testing for the fast reactor environments?

A: You might eventually get there. We have to get proof of concept and material properties and evaluations done first, corrosion as well. There's a lot of steps in there that we need to get to before we can say, effectively we're going irradiate it because there's a challenge there.

NM-4 – Material for Fuel Recycling Applications

Q: For NM-4, can you elaborate on what is meant by sorbent crosscut technology?

A: The crosscut technology means we can offer the sorbent material for both aqueous process and salt process. In any case, if you focus on iodine capture that should cover both aqueous and salt, but if you want to separate them that’s okay as well. What we’re looking for is sorbents that could capture either iodine or krypton. We don’t expect there’s likely to be a single sorbent able to capture both but we might be surprised.

Q: For NM-4, do proposals need to address capture of both noble gasses and iodine species including organic species?

A: No, it could be either for iodine or for noble gasses. We prefer to have a sorbent to catch all, but we understand it may not be possible. Our goal is to simplify the capture process. Some sorbents can capture iodine and noble gas but so far, their performance is low. In this case we prefer to have a simplified sorbent that can capture all gaseous material but again, if we can separate that that’s fine with us if you can demonstrate that.

Q: In NM-4, would sorbents using other metals be open for consideration?

A: Absolutely, we will welcome sorbents using other metals.

Q: My question is specific to NM-4. I noticed that the FOA suggests that the focus is primarily on offgas capturing and the probably also the development of new ways forms. My question is about

whether there's any interest in focusing on the performance of the existing candidate nuclear waste form in some critical environments.

A: For the NM-4 area we are interested in the source materials for the offgas capture and for advanced waste forms. If it's not in those two areas, it could be in the other category.

Q: I have a question for NM-4, materials for fuel recycling applications. For the new sorbents that we plan to develop for offgas capture, are we also supposed to propose the consolidation of these new sorbents into advanced waste materials, or should the focus be given on the development of the sorbents and their testing rather than the consolidation part?

A: It could be either or, not necessarily both. You can concentrate on just the development of the sorbents, or you can also mention the consolidation techniques and processes. Think about what you're going to do with the material you've captured and what it's final disposition would be. Do you need to recover it from the sorbent? Is that sorbent going to be incorporated into something or does it become the waste form itself? Anything that you can say along those lines or propose along those lines helps on the development of the sorbet material itself. It's really important that you convince us this is important for the sorbent material or you let us know why you would need to separate this as a 2 steps. It would be desirable to use one material for both purposes.

NM-5 – Other Advanced Nuclear Material Topics

Q: For NM-5, can one propose development of advanced alloys including design, high-temperature mechanical corrosion, and radiation damage resistance characterization for advanced reactors?

A: Yes, that would be part of the scope. I would encourage you in your proposal to discuss why your ideas are better than what we have now with the current state-of-the-art, how it can be improved, and particularly what reactor type you'd be looking to advance the state-of-the-art for materials development for.

Q: For NM-5, does it have to focus on the different areas that you propose, like for example irradiation or a composite material?

A: No, for the other category it could be any type of materials research that supports the Office of Nuclear Energy's mission. Within our light water reactor sustainability program, we do have concrete research going on, so that concrete research is within our mission. If you if you propose under NM-5 in particular, you want to make sure that you spend some time talking about how your research supports our mission to make sure that connection is made.