FY22 CINR Webinar

August 9-12, 2021

Work Scope Q&A – Alphabetical by Work Scope Code

CINR FOA Overview

Q: In light of the currently, zeroed out budget status for the VTR program, will there possibly be any work scopes added to support work that might have been previously captured by that program?

A: There is still going to be consideration by DOE-NE management along with any input we get from this webinar that will go into the final workscope draft.

Q: Do you possibly know what the general topics might be for the UK collaborations that you're trying to work on right now?

A: We have not heard back from them yet so I would hate to guess. I know that over the past several years, they have done a variety of different things. We had hoped to have some information back before today because we thought that question might come up, but we do not have any information for that right now. But, as soon as we do, that is something that we can post and get out there. Maybe even before the FOAs are release. Dr. Gilligan added that in the past, as mentioned above, the materials area seemed to be popular with UK so keep your eyes open for that.

Q: Could you clear up details on relevance and priority scores? I'm not clear on the difference and who gives the scores? TPOC, FPOC, or someone ese at DOE labs?

A: The relevancy score is split into two different sections. If you look at the funding opportunities that have been released in the past, you will be able to see these breakdowns that has been previously discussed. But the relevancy score is broken down into two sections which is the relevancy aspect, meaning, how relevant is the project as presented to the scope. Program priority is how relevant is the proposed project to the program. So, you can think program priority has a couple of different components that a relevancy reviewer would consider. That may include: is there already funded work like this in the program and did they already have data from the national laboratories or from other university projects that would make that duplicative? There are several different things on program priority that are considerations about what kind of positive or neutral impact would it have on the program.

As for the other half of that question, those relevancy reviewers are selected as part of the merit review process and there is not more information that I can give you in regard to relevancy reviewers, but they are a part of the merit review process and part of that selection process. Dr. Gilligan added that typically the relevancy is assigned by two parts. Usually, a DOE manager and then also a TPOC lead or TIO lead. It could be a national lab person or another DOE person. So, it's a mix of those two.

Q: Do we know when the work scopes are expected to be finalized?

A: The work scopes will be finalized when the FOA is released in its final format so that will be one of the driving factors for getting the FOA out. With that being said, before the pre-applications are submitted, there is the ability to potentially alter those work scopes in some format. Please be aware that they should be in final format by the time the FOA releases, but there could be some additions or subtractions up until the pre-application due date.

Q: Is input provided to the PI for rejected pre or full applications?

A: Yes. There is an invitation or not invited letter that is sent out during the invited process in December. It typically has included feedback from both the relevancy and the technical review side and is considered an official debrief by DOE-Idaho, in the merit review space. What that means is, you will get some comments back about your pre-application including the general idea of where it was evaluated. For example, it would say whether it was evaluated (moderate merit or high merit) and a few comments.

During the full application phase, the same process will occur where an email will be sent out as a formal letter from contracting officer that does have a debrief document attached to it. It includes reviewer comments.

Q: Do awarded projects have review scores posted or could they be posted?

A: No review scores are not posted and no, they cannot be posted.

Q: Is there any consideration of including reactor I&C work within the NSUF scope in the final call?

A: That is a good question and one I can't answer at this moment, but we can take that back as feedback and provide maybe a more in-depth answer later. You can also ask the NSUF folks when they do their presentation. Presentation will be this afternoon and it starts at 3 PM Eastern time today.

Q: If one starts a position at another university, should that university be listed as the institution of the applicant for the pre-proposal?

A: If I understand the question correctly, it would be one where a PI is at their current institution, and they would be moving to a new institution. In that type of a circumstance, the applicant, meaning the university that is going to apply for the award, needs to submit that application. That would mean that the new institution would need to submit that application, not the institution that you're currently at. If at all possible, get a project or faculty status at the new institution, as soon as possible, so you could submit it from the new institution. But, in either case, the earlier you let us know what's happening the better and the more flexible we can be, if any at all.

Q: Will the HPC, high performance computing, NSUF-2.2 count against the six project slots?

A: Typically, NSUF-2 applications don't count toward the eligibility restrictions. That final language will come out in the final FOA. Please pay attention to that. But that's how it has been arranged in the past.

Q: Is there a limitation on the number of applications you can be on as a collaborator?

A: If you are a university PI, you can be listed on six applications with no more than three as lead PI. If you are a national laboratory or an industry collaborator, there are no restrictions.

Q: It was mentioned that MSI led proposals are encouraged. Does it make a difference if an R&D or IRP Appendix C proposal is MSI led versus if the MSI is only a collaborator on the proposal?

A: That is really dependent on what the team makeup is and all of those other types of factors. I wouldn't necessarily want to comment in that space other than the significant contributions from MSIs is what the Department is looking for. Whether that's in a lead capacity or whether that's in a strong collaborating or support role. It is really dependent on the specific situation.

Q: Do we know how the MSI participation is going to be weighted in the proposal whether they're as the collaborator versus the lead PI?

A: Some of those details will be published for the final funding opportunity on criteria. So, I can't make a comment right now on specifics, but they will be described in the FOA.

Q: Are any rules governing participation in more than one NEUP IRP proposal as a national lab employee?

A: The FOA does not prohibit an individual from collaborating on multiple different proposals.

Q: Can we send in comments on these draft work scopes?

A: Please send any comments to neup@inl.gov.

Q: Can the same university co-PI participate in more than one white paper?

A: Yes, provided specific applications restrictions are met as stated in Part III (Eligibility Information) Section A.5 of the CINR FOA. If you are a university PI, you can be listed on six applications with no more than three as lead PI**.**

Q: Can the design of advanced heat exchangers alone be an application?

A: Please see individual work scopes and ensure the proposal aligns with the appropriate work scope's objectives.

Q: If an applicant as lead PI has an active project under a specific program area and work scope, does this affect eligibility or likelihood of receiving an award in the same program area or work scope in the upcoming year?

A: No, lead PIs can apply in accordance with the eligibility restrictions.

Q: Will the restrictions on Appendix B applications by institutions still be in effect?

A: NSUF-2 scopes are exempt from the eligibility restrictions. Since NSUF-2 scopes are the only scopes in Appendix B, this limit will not be enforced.

Q: Will an IRP lead still have the same restrictions on IRP and non-IRP proposals submittals in terms of PI limit?

A: Yes.

Q: As the MSI was encouraged for this year's FOA/webinar, is it just for the work force development relevant proposals or it will be beneficial to all of the technical proposals?

A: All technical proposals are encouraged to have MSI, including HBCU and TCU, involvement.

Q: For the Diverse Team consideration, are only HBCUs and TCUs eligible, or does any MSI count?

A: There is a focus on HBCUs and TCUs but all MSIs will receive consideration.

Q: A person can lead at most 3 proposals, and participate 6 in total. Does co-PI count as lead?

A: A co-PI/collaborator designation does not count as lead PI.

Q: Is there difference between co-PI and collaborator?

A: There is no difference between a co-PI and collaborator for this FOA.

Q: I have a question regarding how to count an existing CINR funded project towards the number of proposals I may submit. I was a collaborator for only one year on a sub-contract of a still active NEUP project. So, fundamentally, does this project count towards my quota of existing funded projects for FY2022 submissions or not?

A: For awarded projects, the restrictions are in place for lead PIs only. Since you are a Co-PI/collaborator on this project, it would not be counted.

Q: Are any rules governing participation in more than one NEUP IRP proposal as a national lab employee?

A: The FOA does not prohibit an individual from collaborating on multiple different proposals.

Q: Are there any restrictions such that we could not partner with both universities if both universities receive an IRP award?

A: There are no restrictions for collaborators to participate in IRPs, so partnering with both universities is not a problem.

Q: Which work scopes require a Letter of Intent?

A: NSUF-1 and NSUF-2 scopes require a Letter of Intent.

Q: Do IRP project counts towards the project number limit (6 projects, and 3 PI). Does it require pre-application?

A: IRP does not require a pre-application. There is only one application phase for IRPs. For eligibility, please see Part III Section A of the CINR FOA, which states that a lead PI is ineligible to apply to any area of the CINR FOA as lead PI if the PI has a currently funded IRP that will be active after December 31, 2022.

Q: For the Infrastructure project, does it count toward the project number limit too? It does not require pre-application, am I right?

A: Infrastructure awards do NOT count toward CINR R&D eligibility restrictions and there is not a pre-application phase for Infrastructure, either.

Q: As far as I know, a lab person can be involved in multiple NEUP proposals as a lab collaborator under the same topic of CINR. There is no restriction on this. Is this correct?

A: We don't have restrictions on how labs can collaborate on university proposals with the exception that no more than 20% can go to non-university collaborators.

Q: Is the university lead the only submitter for a proposal?

A: In the CINR FOA, Appendix A and Appendix C work scopes must be university-led, whereas National Labs may lead only in Appendix B (NSUF-2).

Q: If a PI has no current R&D projects and plans to be the lead PI for an IRP proposal, could the PI be the PI or co-PI of any pre-application from Appendix A?

A: If a PI submits an IRP as lead PI, they should not submit other R&D applications as lead PI. Submitting an IRP as lead PI would not affect their ability to participate in other applications as co-PI/collaborator.

Q: Can a lead PI for a current R&D project also be the lead PI for 3 pre-applications and co-PI for another 3 pre-applications, all from Appendix A?

A: Yes, this is okay for pre-application submissions. Note that they can only submit as many full applications as they could be awarded (only three R&D projects may be funded at any time).

Q: Does an IRP proposal count towards the six pre-application limit?

A: Yes, PIs should not submit more than six applications to the CINR FOA.

Q: Can a co-PI for a current R&D project be the lead PI for 3 pre-applications and co-PI for another 3 pre-applications, all from Appendix A, while also submitting an IRP proposal (in Appendix C) as a co-PI or collaborator?

A: In a collaborator role, yes. Note that a PI cannot submit an IRP AND R&D application as lead PI.

Q: Can a co-PI for a current R&D project be the lead PI for 3 pre-applications and co-PI for another 3 pre-applications, all from Appendix A?

A: Yes, this is okay. A University PI can submit up to six applications, three of which can be submitted as lead PI.

Q: I have a question for you regarding collaborators. This work scope in particular seems particularly suited to collaboration between the university and tribal, state/local, or other groups. However, given the fairly short window for preparing the pre-application, I am not sure if we will formally have collaborators on board at the time we submit the pre-application. We would intend to finalize those relationships before submitting the full application. I see that, according to the instructions, the named collaborators identified in the pre-application may not be changed in the full application without Contracting Office consent. Would it be appropriate for us to identify some potential collaborators in the pre-application, and indicate that we intend to finalize the collaborations before submitting the final proposal? If you would like, we could limit the list of potential collaborators to organizations with whom we have an existing relationship – for example, certain tribal governments?

A: To list a collaborator on a pre-application we do need confirmation that they have agreed to participate in the project. You will confirm that you have listed all participants and that they have agreed as part of the pre-application submittal form. This doesn't necessarily mean that every detail has been hammered out, just that they give you permission to list them on the application. If you can't get

agreement, you can add collaborators before the full applications are due with Contracting Officer consent and I would encourage you to take that path when you have finalized agreements for those collaborations. DOE-NE understands that teaming arrangements can change and will consider each request to make sure the change won't violate any provisions of the funding opportunity.

Q: I was looking for clarification about submitting multiple pre-proposals to the same work scope. Is this allowed? Is this allowed if I am the PI on both? Is there a restriction in the case that both get called for full proposals?

A: Yes, multiple proposals by the same lead PI can be submitted to a single work scope, as long as the application restrictions in Part III Section A5 of the FOA are adhered to. (Note that the same proposal cannot be submitted to multiple work scopes.)

Q: I am interested in submitting an R&D proposal for a program area in which the project timeline indicates "up to 3 years". If it is possible to execute the project scope in a shorter amount of time, would there be any disadvantages in proposing to do so? For example: proposing to perform the project in 2 years, using the same amount of funding.

A: Yes, the project duration can be "up to 3 years" (or the maximum duration specified for the work scope) and any duration as long as the maximum duration is not exceeded.

Q: I would like to clarify the eligibility of a lead PI to apply for an IRP opportunity as per the following: "For IRPs, an applicant is ineligible to submit an application as the PI if (s)he is designated as PI for more than one currently funded DOE-NE project that will be active beyond December 31, 2022." Are there any exceptions to this eligibility criteria for a PI who was recently awarded a FY21 R&D award?

A: The eligibility criteria you quoted is correct for IRPs. Because the lead PI will have an active award beyond December 31, 2022, this PI will not be eligible to submit an IRP application as lead PI. However, this does not preclude the PI from participating in the IRPs as a collaborator.

Q: I was awarded a FY21 R&D project. Do eligibility conditions in the DE-FOA-0002516 prevent me to be a PI or a Co-PI in projects involving the type of UK-US collaboration?

A: You are eligible to participate as lead PI on a full application, such that you have no more than 1 IRP or three R&D projects funded at any one time and are not submitting more than would be allowed by these restrictions. Because you are eligible to participate as a lead PI, then you would be able to collaborate with a UK partner in the RCUK Energy Program research opportunity.

Q: Since the FY22 CINR work scopes were changed (from draft to final) and some reflected a decrease in funding, can the PI supplement a shortfall, from other sources, in order to keep researchers on a project?

A: This supplement should be fine as long as it is well explained. Also, the CINR proposal amount can't be listed above the dollar amount listed in the official CINR call.

Q: I was awarded a FY21 R&D project. Do eligibility conditions in the DE-FOA-0002516 prevent me to be If I request a no cost extension on an active award, would this affect my eligibility as lead PI for future NEUP projects?

A: As long as the no cost extension does not go beyond December 31, 2022, it will not affect your eligibility as lead PI for FY22 CINR projects.

Q: What is the period of the R&D funding, say starting on 11/01/2021 to 10/31/2025 for a 4-year project? It does not seems be specified in the FOA.

A: Typically, awards begin on October 1 and end September 30 for the duration of that award. Using your example of a 4 year project awarded in 2022, this would (typically) begin on 10/1/22 and end 9/30/26. I say "typically" because this duration can change during award negotiations.

Q: Are we permitted to provide a letter of support from an external collaborator who would be unfunded or should we list such personnel as key collaborators with no funding?

A: Please list the person as a key collaborator with no funding rather than adding a letter of support.

Q: In the pre-application stage, is a $ dollar amount budget enough? How much detail is needed for the budget?

A: The estimated cost of the project (not including value of NSUF access) in a dollar amount is sufficient, along with the source, scope and duration of R&D funding.

Q: Can we have international collaborators on R&D projects? If so, can they be paid from the project?

A: International collaborators are allowed and encouraged. As stated in Part III Section A of the FOA, while international partners are encouraged to participate, no U.S. government funding will be provided to entities incorporated outside of the U.S. or to a foreign government or any entity owned or controlled by a foreign government.

Q: I had a query regarding the NEUP RFP. I have an industrial collaborator who will get 10% of the budget as consultancy costs. However, we are also planning some experiments for which we will use the company's equipment. Can we allocate funds (from the remaining budget) as service to the same collaborator?

A: No more than 20% of the overall budget can go to non-university partners. How the 20% is divided up between collaborators is up to the applicant.

Q: I'm writing to ask about the NEUP online application form regarding the budget of UK collaborators for several eligible work scopes. We understand from the FOA that UK collaborators will receive funding from Research Councils UK. So in the pre-application stage, do we need to fill in the specific budgets for UK collaborators in the application form? Is there a guideline (or website) about the UK funding source that we could look at to understand the process?

A: I don't have the current information from the UK on their funding process. For our process, please include the UK budget number and the US budget number separately in your narrative so we can understand how the project will be coordinated.

Q: Does the total budget limit include what will be given to the US and international team or does the limit only apply to the US team because the UK team will get their funding individually? I just want to be sure I understand what documentation is needed and the budget limitation.

A: The budget limitation refers to the US request. The UK will respond to its own funding opportunity. Please do include the UK contribution in the project narrative, along with the overall US budget request so we can understand how the two requests will be coordinated.

Q: I'm putting together a pre-application that will likely involve a UK university. How do we indicate on the pre-application that the UK partners will be involved? What specifically is needed for this?

A: They should be included in the narrative and benefits of collaboration. If the UK request is known at the time of pre-app submission, we prefer to have both the U.S. budget number and UK budget number included in the narrative. Typically, folks add that information at the very bottom before references. Without eating up too much space in the narrative, it is nice to know what will be UK Research Councils supported vs. what will be supported by the U.S. budget request.

Q: Should UK partners be included as collaborators? or co-PIs? Do we have any notation of what the UK funding level would be for an individual project?

A: Yes, they should be included as collaborators in the 'foreign partners' section, you can list foreign project funding there as well. The UK partner should be defining funding for the project on their side.

Q: A quick set of questions, for the UK partner organization, what should I put for funding on the pre-application on the NEUP website if we do not know the funding levels by Wednesday? Is there anything specific I need to denote in Benefit of Collaboration or Pre-App for them as foreign collaborators? Is there anything that would be disqualifying?

A: If you know estimates you can add them to the website. If you don't have estimates, you can leave it blank. It is helpful if you can denote them as collaborators that may be supported by RCUK. I don't have specific direction on whether to do that in the pre-application narrative or benefits of collaboration. I'm not sure I understand what you mean by disqualifying. The known collaborators need to be listed and application page limits need to be kept.

Q: I was wondering if any bibliography cited in the narrative must be included within the 5-page limit of the pre-application narrative.

A: Yes, all content is included in the 5-page limit. The entire document should not exceed 5 pages, including references, bibliography, title page, etc.

Q: The past few years page requirement for the CINR technical abstract used to be 3 pages long, but this year it can be up to 5 pages, is that correct?

A: Yes, this is correct. The page limit was changed this year.

Q: Do I list everyone named on the project (domestic partners) and how is the funding entered?

A: Estimate the funding numbers at this stage. The budget at this stage is a rough estimate. If you are unsure you can also put $0 in the funding area for each collaborator.

Q: Does only the lead PI provide a list of publications from previous DOE-NE funded projects, or should all the team members (including the PI, co-PIs, collaborators) provide a list of their publications from their funded projects?

A: The requirement is for the lead PI to list all publications from DOE-NE funded projects but it would be nice if you could include all team members.

Q: For each publication, do we need to refer it to the specific DOE-NE funded project?

A: On the second question, yes. Please include the CINR tracking ID number and the DOE-NE project number, if available.

Q: We are taking advantage of the UK collaboration/funding thing. For our UK collaborators, do they list the funding they are applying for on here, or do I put that as $0 since they aren't getting NEUP funds?

A: You should put them in the 'foreign collaborator' section and estimate the foreign funding they will receive from RCUK.

Q: Can you clarify what is considered Protected Personally Identifiable Information for the Narrative document - should we not be identifying any facilities we will be using to perform the project except in the "Collaborators" document? As well should we not mention previous projects that may be linked to our laboratory due to the specific nature of the project?

A: You should identify facilities that will be utilized, as well as identify all collaborators. This shouldn't be limited to the collaboration document. Institutions and projects are not considered protected personally identifiable information. Rather, the protected personally identifiable information would be specific information that could be used to trace an individual's identity, if used in combination with their name. This type of information (like a U.S. visa number, passport number, clearances, etc.) should not be included in the application.

Q: Is the collaborator funding supposed to indicate how much funding each collaborator is assigned in the proposal? And should the numbers add up correctly to the total?

A: The funding should be the best estimate for each collaborator at this point and the portions going to collaborators and all other costs should not exceed the maximum funding level for that work scope.

Q: The provided Current and Pending Support template does not have a section for a scope/abstract for each entry. However, the checklist for avoiding common errors section of the FOA notes that we should be including this information. This section also notes "complete listing of all activities" - does this mean not just federal, because the template notes federal support only? Which is accurate?

A: The Current and Pending Support template does not have a location for scope/abstract information and it is okay to use the template as it is and ensure it is entered completely. The Current and Pending Support document should be completed for *only* federal supported activities.

Q: Do we need to provide Current and Pending Support document for unfunded collaborators? It is unclear from the FOA.

A: The Current and Pending Support document should include *all* university and industry collaborators, regardless of funding level.

Q: Are National Lab/FFRDC collaborators required to complete Current and Pending form?

A: No, the Current and Pending Support document is only for University and Industry applicants/collaborators and is not required from the FFRDC collaborators.

Q: I'm preparing a full application with university collaborators from UK, and I wondered if the general required docs for university collaborators are also applicable to them. Since they would be funded by UK if the proposal would be selected, do I need to submit their budget forms when submitting the full app? How about other materials such as current and pending, and performance site location?

A: The general required documents for University collaborators are not required for the UK collaborators. However, please list the UK collaborators under the foreign partners section, where their foreign funding should be identified.

The UK budget number should be included in the narrative and/or benefits of collaboration documents to ensure understanding of how the project will be coordinated. The UK budget forms do not need to be submitted.

As for the Current and Pending Support (CPS) and Performance Site Location, these are not required for the UK portion. The performance site location is only for the work being performed as part of the described scope for the U.S. federal request.

Q: I understand that letters of support from colleagues or institutions cannot be included in the application, right?

A: Letters of Support should only be included for IRPs or the MS-NE-1 or MS-NE-2 works scopes and are not applicable for any other work scopes. For these work scopes, only, letters of support should be uploaded to the "Budget Justification" area.

Q: Should we list UK partners in the pre-application and maintain them in the application with $0 budget?

A: UK collaborators should be listed in the foreign partners section and their UK funding should be shown under foreign funding.

Q: Could we allocate funding for interactions with UK partners, such as travel to UK institutions?

A: International travel is allowed for project participants that are working at U.S. institutions. A visiting type arrangement would need to be negotiated with DOE-ID upon award negotiations, depending on what is allowable or unallowable.

Q: In the full application, can we change the proposal title?

A: Title changes must be approved by the Contracting Officer, so please send any proposed title changes to NEUP@inl.gov for review.

Q: How much information in the UK proposal should/can be included in the US proposal?

A: The CINR proposal should include enough detail in the narrative, benefits of collaboration, etc. so that there is clear understanding of how the project will be coordinated. How much details is left up to you to determine. The UK collaborators should also be included in the foreign partners section and the amount of foreign funding should be specified there.

Q: Will the UK proposal be reviewed by the DOE panel?

A: No, the RCUK proposal will not be reviewed as part of the CINR panel review process.

Q: If the UK proposal is not funded, can the US proposal will be funded or vice versa?

A: These are separate funding opportunities and will be treated as such, but it is important to ensure that the U.S. work can be performed without the UK portion if the UK portion is not funded.

Q: The CINR FOA provides a threshold of over 250k or over 50% of the project requirement for the subcontractor budget template and justification to be uploaded with the application. But in section E.10.4, it says they are required for ALL subcontracting institutions regardless of the budget amount. Can you clarify?

A: A Subaward Budget and separate Subaward Justification are only needed for those collaborators who meet the minimum requirements (work over $250K or more than 50% of the total work effort).

If the subaward does not meet these minimum requirements, then a separate subaward budget is not needed. A budget justification (whether that is included in the overall budget justification or a separate subaward justification) must cover all costs required to support the project and do need to cover the subawards.

Q: The RFA lists that all collaborators' CVs are required, but the online DOE NEUP application lists that only up to 5 collaborator CVs can be uploaded.

A: The application system does allow for more than 5 collaborator CVs and all collaborator CVs should be uploaded.

Distinguished Early Career Program (DECP) FOA Overview

Q: Which of you should we talk to for the DECP?

A: Please send all questions to neup@inl.gov and questions will be answered and posted in the FY22 Q&A for the community.

Q: What is the expectation of the topics for the Distinguished Early Career Program?

A: We will cover the Distinguished Early Career Program with its own presentation later today. That is going to be wide ranging. The Distinguished Early Career Program is really focused around supporting DOE-NE mission, similar to some of the things that Jeff talked about at the beginning of this presentation. The three priorities for DOE are going to really focus around being able to meet research and educational objectives in one of those areas.

The DOE-NE mission does not include fusion, medical physics and a few other topics. It does include the wide range of program areas that you typically find awards being made and it also includes an educational component as well as the research component. It is an integrated type approach.

Q: Is the Distinguished Early Career Program only for tenure track and not for associate professors?

A: The PI must be an untenured assistant or associate professor on the tenure track at a U.S. academic institution as of the deadline for the application. The PI must be employed in the eligible position as of the closing date for this FOA.

Q: Can Distinguished Early Career Program projects have a co-PI?

A: No, there can only be a single PI.

Q: Are subawards to collaborators up to 20% allowed in these proposals?

A: There should not be any co-PIs or collaborators. This is a single PI focused on both early career development and education.

Q: Can associate professors without tenure track apply to the Distinguished Early Career Program?

A: The PI must be an untenured assistant or associate professor on the tenure track at a U.S. academic institution as of the deadline for the application. The PI must be employed in the eligible position as of the closing date for this FOA.

Q: Is there an institutional limit on the number of Distinguished Early Career Program applications?

A: No.

Q: Can a national lab employee apply for the Distinguished Early Career Program?

A: No

Q: Would national lab employees be considered viable in the Distinguished Early Career Program?

A: No, the program is for untenured assistant professors and associate professors on tenure track.

Q: Is there any limit to how many Distinguished Early Career Program proposals can be submitted by any one institution?

A: No

Q: How many times can a tenure track assistant professor apply for the Distinguished Early Career Program?

A: Only one application on behalf of a PI may be submitted in any given NE DECP competition. A PI may not participate in more than three NE DECP competitions.

Q: Do we have any knowledge of the anticipated number of Distinguished Early Career Program awards we might be able to give this year?

A: DOE anticipates that, subject to the availability of future year appropriations, a total of $2,500,000 in current fiscal year funds will be used to support awards under the FOA. Awards are fully funded in the first project year.

The total number of awards will depend on the number of meritorious applications and the availability of appropriated funds. The ceiling and floor for this FOA are the same. The maximum award for the DECP is $625,000 over five years.

DOE anticipates up to 4 awards under this FOA. The exact number of awards will depend on the number of meritorious applications and the availability of appropriated funds.

Q: Is the NRC faculty grant considered previously Distinguished Early Career Program Federal funding?

A: We would have to look into that. I don't think NRC has a Distinguished Early Career Program. I think theirs is more tied to their programmatic needs. So, if you're talking about the current NRC research awards, no, that's not a Distinguished Early Career Program. That would not be duplicative. The NRC has run a faculty development grant program before, but I will need to look into that and provide some guidance there. The one that's granted to the PIs is typically the department head and that is not the same as the Distinguished Early Career Program. Distinguished Early Career Program has to be submitted by the individual faculty member here.

Q: If a PI has not received an NEUP award previously, will that impact them negatively for consideration of the Distinguished Early Career Program?

A: No, it will not negatively impact them for consideration.

Q: Is there a timeline and budget for Distinguished Early Career Program awards at this time?

A: At this point, we have an anticipated budget of $2.5 million which would be about four awards. We will discuss details on submission deadlines, but the full applications will be due by February 23, 2022 at 7:00 PM ET.

Q: Can letters of support be provided for Distinguished Early Career Program applications?

A: Yes, there is going to be a requirement for a departmental head letter of support that not only describes a letter of support, but also a description of how the department is dedicated to nuclear engineering and nuclear energy in general. There will be some guidance on what the letter of support will entail.

Q: Does participation as a sub-award on a DOE SBIR award prevent a junior PI from submitting to the Distinguished Early Career Program?

A: No, it does not prevent one from submitting to the Distinguished Early Career Program.

Q: Does the Distinguished Early Career Program apply to researchers starting their career within the first three years?

A: The PI must be an untenured assistant or associate professor on the tenure track at a U.S. academic institution as of the deadline for the application. The PI must be employed in the eligible position as of the closing date for this FOA.

Q: Can a faculty member in the mechanical engineering department apply for the Distinguished Early Career Program?

A: Yes. We will get into more specifics, but the idea here is it is focused on DOE-NE mission which is not exclusive to nuclear engineering departments.

Q: Are incoming faculty for Fall 2022 eligible to apply? Specifically, in my case, I have an assistant professor appointment which I have deferred to the fall of 2022.

A: There will be specifics that come out in the funding opportunity, but refer to the statement I made before, that you need to be in the position. You need to have the appointment start before the full application is due. If you meet those conditions, then you will be eligible to apply to the Distinguished Early Career Program. Some universities do allow people that are not in the position, as yet, to apply for funding. If your university is going to allow you to serve as a PI, even though you are not an employee, then I would find it highly questionable. But, that is really up to the individual institution. Similar to CINRs, the institution will be the applicant. Meaning that there will be the applying institution with the specific PIs as the named PI for that application.

Q: Do early career lab staff qualify for the Distinguished Early Career Program, or only university staff?

A: The PI must be an untenured assistant or associate professor on the tenure track at a U.S. academic institution as of the deadline for the application. The PI must be employed in the eligible position as of the closing date for this FOA.

Q: Can a PI apply to the Distinguished Early Career Program from both the DOE-NE and DOE-BES in the same fiscal year?

A: You can only accept one, from what we understand. We have not run into that situation, but they would only be able to accept one of those awards. We have not necessarily considered all the intricacies there, but the idea would be, you are only allowed to win one of those Distinguished Early Career Program awards.

Q: Are Postdocs eligible to submit to this FOA?

A: It may depend on what your status will be and what appointment you will have as the due date comes up for the FOA. The PI must be an untenured assistant or associate professor on the tenure track at a U.S. academic institution as of the deadline for the application. The PI must be employed in the eligible position as of the closing date for this FOA.

Q: Is there also a pre-app deadline?

A: There is not going to be a pre-application for this funding opportunity. The FOA will release and the due date will be February 23, 2022 for the full application.

Q: Will early faculty from an MSI HBCU be given special consideration?

A: Eligible individuals with the skills, knowledge, and resources necessary to carry out the proposed research as a PI are invited to work with their organizations to develop an application for assistance. Individuals from underrepresented groups, those with disabilities, and people from all geographic and economic backgrounds, are encouraged to apply. In addition, DOE-NE strives to ensure energy justice and is fully committed to broadening the inclusion and contribution of those communities that have been historically underserved within its programs. Eligible PIs from minority-serving institutions (MSIs), Historically Black Colleges and Universities (HBCUs), or institutions located in overburdened and underserved communities are highly encouraged to apply to this FOA.

Q: How is the FOA different from the CINR FOA?

A: There are two components that are different. The first is the restriction to early career faculty. It's a relatively narrow window for early career faculty to compete for these awards. The second point is this is not solely a research funding opportunity. The focus is on both research and education and that is a key component that is different from the CINR FOA. It is not tied to a specific workscope. The workscope for the research program and education program is defined by the applicant, but it has to be within the DOE-NE mission.

Q: How will the focus of this DOE-NE Distinguished Early Career Program award be different from the one in DOE-BES career awards?

A: You would need to look at the criteria for their award. There are some similar things and some different things. DOE-BES is a much larger program and include national lab people. This is focused just on untenured assistant or associate professors on the tenure track. The BES is also a broad range of science outside of nuclear energy as well. There are some individual differences of the two, but this is focused on DOE-NE mission. From what we understand, DOE-BES is research focused and not research and education focused.

Q: How much funding or percent of funding would be allowed to be spent on capital equipment in one of these awards?

A: We don't have a specific percentage that we've identified in the funding opportunity. An important component of that aspect is taking a look at and considering the merit review criteria and understanding what the priorities of the program are. If it is a reasonable request that supports both the research and educational outcomes that the PI is trying to get to, it could be considered. There will need to be a balance of the purpose for the funding opportunity. Equipment and other things like that are dependent on the research area. At the moment, there is not a specific area we want to restrict based on a

percentage amount. Most universities will provide the individual with a sizeable startup package. Much of the equipment, realistically, should already be there and paid for by the university.

Q: Would you recommend that the PI invite senior faculty or lab staff personnel to be on an advisory capacity on one of these proposals?

A: No, it would not be important to do so. It's going to be the commitment by the department head and a single PI with their actual research. Having others listed as supporters or anything like that would be irrelevant and not considered.

Q: Do we have an estimate of when the awards might be announced?

A: It is anticipated that the award selection will be completed by June 2022. It is expected that awards will be made in Fiscal Year 2022.

Q: Is an engineering type proposal preferred?

A: As long as you are working in a DOE-NE mission area and make it relevant to the DOE-NE mission you could apply even in a more basic science area. You have to take a look at the kind of work that's done at DOE-NE and the kinds of programs that they support.

Q: If a PI was awarded, would they be restricted from applying or accepting future career awards such as NSUF, DOE, and DARPA?

A: Our eligibility rules would preclude you from accepting. I am not aware of all the different or every single Distinguished Early Career Program awards and what they're eligibility requirements are. Please refer to those as they come out and make a determination in that regard.

Q: Could letters of support from other institutions be provided to support this application?

A: No, what we are interested in from a required documents standpoint is the endorsement letter from the department head. Anything that's not on the application required document list should not be added to the application.

Q: For the education part of the proposal, does it focus on your university education or general education efforts, such as K through 12, publishing, etcetera?

A: Ideally, I would say that it's really focused on the integration of the research with the education. It's not a separate program necessarily. If you are doing outreach and service K-12, that is nice, but the true meaning is to try to capture the research and how it's integrating into your curricula and the impact on students at the university, etcetera. If it happens to be nuclear energy education in the K-12 space, that might be OK. However, DOE-NE mission, the emphasis is not on education itself, especially in the K-12 space.

Q: For the research component, is there any guidance on preference for basic versus applied science?

A: You would need to look at the programs in the DOE-NE portfolio and the kinds of projects that have been funded in the past with emphasis in the various program areas. If you can make a case that very basic radiation transport or nuclear data is relevant and critical to the needs of DOE-NE and you are the one person in the country to do it, you should make that argument. You find past funded projects on the

NEUP.gov website and can look through the variety of different programs and the variety of different research areas which kind of slide along that scale.

Q: Since the work scope will be open, there's no overlap with other CINR applications that is allowed. Does this mean we can only develop a new, independent project?

A: I don't think it is that tightly bound. If you are applying to one of the current workscopes, they tend to be fairly narrow in the whole scheme of things. You could have a little bit of overlap with the work scope area, but not exactly the same application. This is the opportunity you have in defining your own path. If you want to apply to a workscope, you should do that. This is a much more general approach to looking at development of a career at an early stage. The key point there is that what we're trying to avoid is extremely similar research plan on the Distinguished Early Career with an NEUP proposal or application that you put in. The real guidance there is that it's not that it can't have overlap of the workscope but just that you're not putting in the exact same application in two different funding opportunities.

Q: Can more than one PI apply per university?

A: Yes. These are going to be applications made by the university, but there is no restriction on the number of individual PIs that qualify based on the eligibility requirements to apply.

Q: What is the application page limit?

A: The application page limit for the project narrative will most likely follow the standard DOE-NE page limit of up to 10 pages.

Q: Are non-U.S. citizens eligible to apply to the Distinguished Early Career Program?

A: As long as the applicant is in a tenure-track Assistant Professor position or Associate Professor position at the time of application from a U.S. educational institution, then they are eligible. There is NOT a requirement to be a U.S. citizen or hold a green card to apply for the DECP.

Q: Is a green card holder allowed to apply to the Distinguished Early Career Program?

A: As long as the applicant is in a tenure-track Assistant Professor position or Associate Professor position at the time of application from a U.S. educational institution, then they are eligible. There is NOT a requirement to be a U.S. citizen or hold a green card to apply for the DECP.

Q: If industry advisory is involved, do I need to attach a letter or just need to include the name and role (after agreement) in the project narrative? If a letter is needed, where should this be uploaded?

A: Co-PIs or collaborators are not allowed in the DECP, but you do have full purview of what you would like to add to the narrative. The DECP is not focused on collaborations or advisory style roles for industry, but this is something you can decide how you would like to handle. A letter of support is not needed.

Q: Would the NEET-CTD (AMMT) research program of the DECP be interested in the design and performance of 3D printed heat exchangers?

A: The design and performance of 3D printed heat exchangers is applicable and of interest to the AMMT program. One of the things we would also be looking for is that industry is involved in some way

(advisory). The program is trying to ensure that research and product are directly applicable to their needs and we are developing resources that support it.

Q: I am planning to perform some experiments at an FFRDC as part of a Distinguished Early Career application. These are experiments that cannot be performed elsewhere. Should I budget these costs as a sub-contract to the FFRDC, or will DOE award these funds directly through the Field Work Proposal (FWP) process?

A: Any project funds going to an FFRDC would be provided directly by DOE to the FFRDC via the FWP process. A Field Work Proposal and DOE Contracting Officer Letter of Authorization will be required to be submitted by the applicant. In addition, funding provided to an FFRDC by DOE should be included in your total budget (i.e. As part of the $625,000). Upon successful award negotiation, the funding provided to the University (prime awardee) will be the award amount, minus the FFRDC funding (provided directly by DOE).

Infrastructure FOA Overview

Q: Can a PI from one university submit a GSI and a reactor upgrade proposal in the same year? And are you eligible to apply if you currently have an ongoing reactor upgrade project?

A: Yes and Yes. I believe it was in 2015 or 2016 that the issue of having an ongoing project was removed. We are still getting that question so I am glad the question was asked, but yes, that does not make a difference.

Q: Will video recordings and slides be available?

A: These slides and all of the video recordings will be posted within a couple of weeks on the NEUP.gov website and you can find all those resources there at that time.

Q: Would a reactor beam line installation project be considered for a reactor upgrade application or a GSI application?

A: I'm thrilled that, finally, somebody split the hair there. I think that's a great question and I think it really could fit both. Now, I will just say it would probably score worse in the reactor upgrade on the safety, security, and operational reliability part of it, but probably high on the others. You'd have to really figure out what you thought about it. The short version is, I think it's eligible for both. It would be an appropriate proposal for either one.

Q: It is my recollection that the Reactor Upgrades FOA traditionally disallowed award funding to be spent internally by the award recipient. I didn't see that in the FY22 FOA restrictions on the use of funds, and would like to inquire if another department within my university could create custom-fabricated equipment for our reactor using Reactor Upgrades funding.

A: The answer really depends on the situation. An appropriate basis of estimate or 'vendor quote' is required for any items over $5,000. That basis of estimate would need to be built on standard rates. For example, standard machining costs, not labor costs. The project and associated basis of estimate would need to deliver a part, system, etc.

S&F Institutional FOA Overview

Q: Can students be in any year of their graduate degree?

A: They have to be entering either their first or second year of overall graduate study when the award begins, to be eligible to apply.

Q: Can unofficial transcripts be allowed? Sometimes the cost of transcripts can really be a problem for students.

A: Currently we still require official transcripts. If you submitted them in the past, if you are a previous applicant, especially for our fellows, there is no need to resubmit those undergrad transcripts. We do allow registrar's office to email them if that's allowed at your institution. Otherwise, it can be sent by mail or through the electronic delivery system at the school. The electronic delivery is a really idea because those are very fast and we've had a lot of students miss the deadline because we got their transcripts too late. So that's always a really option if that's available at your university.

Q: Is there a limit to how many fellowships a single institution can apply for or be awarded?

A: There can four per institution awarded, but in terms of submission, there is no limit.

CT-1

Q: Can you point out the differences between cybersecurity of light water reactors and advanced reactors?

A: The differences aren't necessarily in the nature of the reactor, but instead you have plants that were designed and built before modern digital control systems and cybersecurity existed, so we are trying to bring cybersecurity that into an existing environment. There has already been a great deal of success in that environment, so we are not auditing and improving and looking for the holes so much as we are trying to make it more efficient and effective. When you look to advanced reactors, there are a lot of things still open and on the drawing board, how to do design the cyber architectures from the beginning so they are robust? Can you remove dependencies altogether from various cybersecurity aspects? We are looking at the architectures, the way they are designed, the way the controls might be put into place. We are also looking at whether there are advanced parts, components, methods, a whole range of things. However, it's not just looking at architecture; but also looking at if you have advance concepts that get their best value by changing the way things are done. A hypothetical example: if you have a microreactor where the business case is mostly where you use remote control, that would be inconsistent with how microreactor cybersecurity is done now, so understanding where there are technology gaps or mostly regulatory gaps is very helpful. There are things that can be done to really advance specific use cases for the nuclear industry for the advanced concepts that are out there.

Q: I wonder what kind of communications are considered in this work scope? Is it at the level of communications and protocols or is it at the level of physical layer communications?

A: Any and all of those kinds of communications would be acceptable if it's specific to the needs of a nuclear power plant.

CT-2

Q: If the focus was on biofuel manufacture, would that be acceptable in a proposal?

A: It's possible that would be acceptable though it would need to have several other requirements as well.

Q: Is the development of new thermal storage "batteries" using novel isotopes an appropriate topic for this workscope?

A: We are looking at the initial concept that is a separation of these two, but this topic does focus in this area and could be considered. The final application of the heat is to be addressed in terms of appropriate sizing for the specific application. Think of this in an integration approach; how the interface is accomplished, not just the application.

Q: What lifetime are you interested in for isotopic energy sources?

A: We are looking to the applicants to link the lifetime to an application. You would start with an application and develop isotopes relevant to that application. It's on the applicant to develop those requirements.

Q: Should the technology investigated reach the power grid?

A: It's not required, but if you have an idea suitable for the power grid, it's optional.

Q: The different integration systems strongly linked and depend on the strength of the nuclear source. Can you elaborate on this topic?

A: We agree, they depend on each other.

Q: Is the concept using spent fuel dry storage cask is possible?

A: Yes, and how would you accomplish that with those types of systems? This could be an interest as a potential opportunity. The aspects of the regulatory issues could be touched on with the current processes involved.

Q: Is the combination of renewable and fossil energy with nuclear the interest of the call?

A: It could be, but it's not necessary.

Q: Is there a desirable modeling and simulation framework to be used for an analysis, or can an in-house framework be used?

A: This is up to the applicant but is not a hard requirement. If there is something that already exists, that's great. If applicant is looking to develop a new suite of analysis codes, that may not be the best approach. It is recommended to look at the simulation tool set developed by the integrated energy systems program that is used to assess these different systems. It would be beneficial to leverage the capability existing and to ensure that anything new such as a model for an analysis approach that is developed be enabled to be integrated with this broader energy systems analysis suite. Recently the

analysis toolset descriptions have been updated on the IES.INL.GOV. Please take a look at those and understand those toolsets.

Q: For radiation-assist topics, is it necessary to have an experimental component in the project?

A: We are not requiring an experimental component, but it could make for a stronger proposal.

Q: Is there a threshold power level for the decay heat, below which you are not interested in?

A: There has not been a lot of work done to assess the range of possibilities. We are aiming on having a national scale impact. If it's not a large scale, then it needs to have a significant market, with as much utilization as possible in terms of energy. It's more about the cost to implement and the potential benefit if successful. Does it warrant the investment in the technology; look at the cost benefit analysis. We are looking for things that batteries don't already do, and make sure there's a benefit above using battery technology.

Q: Can you talk about the production of tailored isotopes again? I am assuming this is production of isotopes via irradiation/activation which can serve purposes in energy systems and not medicine?

A: That is correct.

Q: Is a focus on the electrical interface between storage, generator, chemical conversion, and hydrogen generation an appropriate topic for a proposal?

A: That is part of the solution, but more it's a focal area on the energy use so you'd need to consider a reference point of a tailored isotope and the heat characteristics of that, or the heat characteristics from spent fuel. And make sure the consideration of decayed heat is taken into account in the system. It's really looking at decayed heat all the way through the application where some may be more focused on the application at one end of the spectrum and others on decayed heat at the end of the spectrum.

Q: What is the motivation of using decay heat in IES? Are there any other similar systems similar or pursued in LWR domain at this moment?

A: This is about looking at something that is not used widely as a resource right now. We want to use all the resources that we have available and turn liabilities into assets.

Q: Will preference be given to applications that utilizing an advanced reactor concept that is further along in commercialization such as SFRs and HTGRs and as opposed to MSRs?

A: To clarify, there is not direct use of a reactor in this workscope. This workscope looks at the decay heat source. There is a preference to using something in existence today or can be produced in the short term.

Q: Who would own the "decay heat" source i.e. used fuel?

A: That would be an innovation that we would like to see in the work of the application.

Q: Is risk/safety analysis considered as a priority for CT-2? Will it be of any interest in this type of analysis for this year IES call?

A: Risk/safety analysis of proposed integrated energy system solutions (e.g., impact of a coupled industrial facility on a nuclear plant risk profile, and the reverse risk of a nuclear plant on the coupled industrial facility) would be of interest. These questions arise in discussions with developers and potential industry users, and will become even higher priority as the Nuclear Regulatory Commission is engaged on these types of installations.

CT-3 (CT-3.1, CT-3.2, and CT-3.3)

Q: The literature review mentioned in CT-3.1, is that available as a report?

A: What we're asking to be done is that you guys do literature research so that we know that you're not duplicating other practices or processes that have already been developed.

Q: You mentioned industry partnership is required. Does a DOE national lab qualify as an industry partner?

A: No, DOE labs are not considered as an industry partner. They're there as a use for anyone who was available, but when we're taught, when we speak about an industrial partner, we're thinking about the actual folks who are going to be deploying this technology on a commercial scale.

Q: These seem to be excellent projects tailored to long term industry needs, however, the budget seems to be rather low regarding the goals. Do you anticipate alignment with other programs, and if you do, which ones?

A: I think that's one of the things that we're asking to be done here…yes. We're asking for creativity. We understand that the budget numbers here are low. We expect that what we develop here is going to be applicable to multiple reactor systems. Specifically, we'll probably be partnering with NE-51 activities and the ART programs as well. Depending on the material systems we would also be inclusive of those folks that are working in our fuels group as well.

Q: For CT-3.3, are you envisioning an in-situ characterization method during the AM process, or can this be ex-situ?

A: Yes, ex-situ characterization processes but in-situ certainly if you adequately define that in your application if it is something of interest. Please make sure to review the current state-of-the-art, regarding characterization of additive processes when you formulate that approach.

Q: For CT-3.3, does additive manufacturing include processes such as advanced electroplating?

A: Yes, go ahead and look at the accepted definition for additive manufacturing which includes a host of processes, directed energy deposition, sheet lamination, powder bed binder jetting, as well as laser powder bed fusion. Those are the main ones that that we would kinda focus on so, please review that.

Q: Are advanced reactor conditions, such as high temperature, non-acquiesced corrosion of any specific interest in CT-3.3?

A: Yes.

Q: On CT-3.3, is there a preference for data collection during the build process versus collected post build?

A: No. No preference. Again, make sure that you have traceable data from a spatial perspective. So, once things are removed from any build plates or larger pieces, it needs to be spatially traceable to where it was during the build and in general because we're looking at those characteristics during the build.

Q: Can you explain how the call this year for CT-3.3 is different from last year's call?

A: So last year's call was very specific on the TCR materials that were available. This one is much more broad. There are specific materials like 316L, 718 and Silicon Carbide that were available last year. Those are possible options, but it is a broader scope this year. I'll add to that, on the method to generate the data, it is also more broad as well. Last year, we were focused on those materials and near-term kind of methods to generate data for qualification of these parts. So, it is significantly different in those two aspects, materials, as well as lessons.

Q: CT-3.3. Does the proposal need to include both mechanical and thermal physical properties, or can the proposal focus on only one of those?

A: They can focus only on one.

Q: CT-3.1. Is this call expected to investigate a specific component system considered in advanced reactor designs?

A: No, it is more to describe a procedure, or a process, of how you would approach functionally graded material to either minimize welds or to provide functionality to a specific part. That is why the focus in the description is that you need to justify why you use the different material types and prove that it is really agnostic, either for metallic-ceramic or metallic-metallic material. So, you need to prove that it doesn't matter what the material is, but it is the process/methodology that you need to develop.

Q: CT-3.1. Are multi materials for fusion reactor components of interest?

A: So, this call is for our Advanced Fission Reactor. So, we're not necessarily interested in advanced fusion materials unless they can be applied to the Advanced Reactor community. But we're not, we're not interested in developing the materials for fusion.

Q: CT-3.1. What environment and conditions would you envision for the functional-graded materials applied as environmental and thermal barriers?

A: Again, we will not be prescriptive to the research community to pinpoint you in one specific or two specific venues. It's all about your approach and how you justify that approach to make it so that it is agnostic. In other words, you can apply the methodology to a variety of systems, not necessarily proving that by different material systems to show that you can use it either/or. Therefore, if you want to go for high-temperature, high -corrosive in one go, that is for you to justify properly. As Dirk said earlier, as well, prevent any duplication of previous work or research well publicized.

Q: CT-3.1. Is 3.1 focused more on modeling and simulation, or on experimental analysis, or is it a combination of both?

A: I would think that it is a combination of both, although, it needs to be validated by your experimental systems.

Q: Functionally graded material, CT-3.1, is similar to some high throughput testing, CT-3.3, such as combinatorial materials study that use graded compositions to rapidly test alloy systems. For a combination materials study on coatings, would you consider that appropriate more for CT-3.1 or for CT-3.3?

A: So, 3.1 is really geared towards the testing itself. Yes, we're interested in data, but that we are developing the concepts of high throughput testing in various, different characteristics of the materials. 3.1 is looking at the methodology of how you verify and certify multi material systems, so I understand how they are related, but at the focus of them is slightly different.

Q: For CT-3.1, the workscope asks for "an agnostic gradient material verification methodology in terms of interface and residual stress requirements interface and residual stress requirements." Besides residual stress, what specific "interface requirements" are of interest?

A: The researcher should justify and discuss the interface requirements that would be necessary to be able to evaluate and qualify gradient materials. If you decide there is no interface requirement necessary, you need to justify theoretically as well as experimentally that interfaces does not have an influence on the performance. And the opposite is also necessary. How do you define interfaces?

Q: For CT-3.1, the workscope defines materials and manufacturing as: "dissimilar metallic materials, composite materials and metallic-ceramic material systems fabricated by at least two advanced manufacturing processes for comparative purposes" Is a single proposal expected to cover all three kinds of materials: (i) dissimilar metallic materials, (ii) composite materials, and (iii) metallic-ceramic?

A: Yes

Q: For CT-3.1, will physical vapor deposition and directed energy deposition laser AM be considered acceptable as "two advanced manufacturing processes for comparative purposes"? Or should both manufacturing processes be different variation of the same kind, e.g. laser AM via DED vs powder-bed fusion?

A: You can choose any method of manufacturing with justification why you have chosen these two methods. Therefore, your proposed methods will comply, given you provide justification.

Q: For CT-3.1, given the time limit of only 2 years and budget ceiling of $500K, should the proposal cover both experiments and computational simulations, or will experiment-focused proposals be acceptable?

A: It is expected to have both modeling and experimentation, although given that certain areas may not be fully exhausted. In your planning you should be very clear on the route and approach you are taking for the best effective route with the risks or challenges of the approach and how you will quantify that.

Q: Is CT-3.2 only interested in creep mechanism? How about other properties and phenomena?

A: We picked creep, just, you know, this is going to be a challenging problem with material design and obviously we're interested in creative corrosion cracking, I mean, all of that will be of interest. But, we thought we needed to focus since we're looking at a fairly small year in scope, so that's why we picked creep. Obviously, if you have a really good proposal that can work in two years and $500,000, and take on another physics phenomena, please do, but we decided to pick one to make it more focused.

Q: How about ion irradiation? Is that of interest in CT-3.2 or CT-3.3?

A: For 3.2. Yes. Of course, we're always looking at ion radiation. It gives us opportunities if we can correlate back to a real neutron environment, to be able to do irradiations quicker, faster, and maybe control the physics a little more. Of course, we all know the challenge is tying it back to the real nuclear

reactor environment. So, yes, if there's a strong correlation to our reactor environment, ion radiation is certainly encouraged. Yes, as well, as long as it fits into this narrative of generating data, for a digital platform for 3.3.

Q: CT-3.2. Would nano indentation-based character characterization techniques be considered?

A: Oh, absolutely. And we're also encouraging here if there are ways to integrate multiple tests together for accelerated measurements, that would also be included. We've been looking at nanoindentation too, because it has a possibility of being combined with other tests, so, absolutely, yes.

Q: CT-3.2. Is the creep behavior of nuclear fuels, other than structural materials, of interest for this topic?

A: Yes, that's a good catch. It should say fuels and structural materials. Now granted we are focusing on, you know, in this new area under Dirk, I'm assuming Dirk will jump in and answer this too. We are probably looking at focusing on only a couple of materials so for example, like 316 stainless. However, developing the capabilities to design a fuel would also be of interest. So yes.

Q: Follow up question for CT-3.3: Are there any published technical reports that could be recommended?

A: Yes, absolutely, TCR.ornl.gov has, in general, the most recent, up to date information on what has been published regarding in-situ data, that we're taking, the concept of the digital platform for ART certification, as well as the data that we have generated from additive manufactured components and the materials that we're looking at. TCR.ornl.gov/publications has a whole list of those publications, kinda get you, at least, righted in that concept, as well as, the data that we're generating and the methods that we've been using to generate that data.

Q: Would you be interested in the post heat treatment process of 3-D printed materials in one of these work scopes?

A: When we look at this, that almost all the work scopes, post heat treating gets us to the end-product state, in which that is where we're going to be interested in all of the data. So, I think it really, it's going to depend on how the proposal is structured and what they're asking to be done.

Q: For CT-3.2, should the focus be only on additively manufactured materials?

A: So, since we're combining this into this new AMMT, where the focus is advanced manufacturing, we are picking additive manufacturing techniques, as the focus. That allows a natural link, between 3.1, 3.2, and 3.3. So, I think the preference would be yes. But, if there are unique, advanced manufacturing, I think we would be interested in that… I'm going to pass to Dirk. Dirk, what do you think? I think when we look at all the various ones. I think we're open to it, but we have to remember what the goals of each of these sections are. Especially from the creep methodologies, which can, I understand, can vary, because our materials properties do vary in our structures vary between our different advanced manufacturing methods. So again, it's going to be depending on how well the proposal is written and the specific goals that are going to be accomplished that meet the scope that we've provided. For 3.1, it is not only limited to additive manufacturing because you can produce a gradient material by a variety of technologies to support…it depends on your justification and your approach that you've taken.

Q: Is selective laser sintering considered as a promising way for material synthesis (porosity)?

A: So, I'm not sure that we're going to comment on any specific additive or advanced manufacturing technologies within this forum. That really needs to be left to the proposal and the justification that's being made by the individuals.

Q: Should only fusion or powder based, AM processes be considered, or can solid State AM processes be included?

A: Yes, they can.

Q: For 3.3, are we required to collect the Digital Twin data?

A: It is expected that some in situ manufacturing data will be collected to support demonstration of this novel spatial characterization method. Regardless, data collected and its use should be clearly defined within the submittal.

Q: For CT-3.1, the FOA wording seems to call for proposals with two AM techniques across multiple gradient types (e.g. metal-metal & ceramic-metal). It is unclear if this means studying metal-metal gradients only, but using say laser powder bed fusion and power/wire-based DED would be responsive to the call. Can you clarify? The concern is with the limited time and resources an expansive design of experiment will constrain progress.

A: The workscope's schematic is demonstrated in Slide 8 of the workscope's webinar presentation (https://neup.inl.gov/SiteAssets/FY2022_Documents/FY22%20Webinar%20Presentations/CT-3.1_3.2_3.3%20Workscopes%20FY22.pdf). It is required to demonstrate your approach on 3 material systems and using 2 manufacturing processes each. The manufacturing processes do not need to be all additive, can be other advanced manufacturing methods. As was presented, it is important to justify your choices of advanced manufacturing methods

Q: For CT-3.1, I have your presentation to NRC from last year, but do you have any newer public presentations/publications that can be shared on direction and gaps associated with your program?

A: https://gif.jaea.go.jp/webinar/Series53/Dr.Isabella_van_Rooyen_25May2021_gif_webinar_final.pdf

Q: For CT-3.1, can you clarify the industry partnership requirement?

A: Industry partnership is important to ensure the work is of interest to current developer etc, as it will make the research focused and applicable, increasing likelihood that the technology will progress after completion of the awarded research.

Q: For CT-3.1, can partners be unfunded advisors or must funding be allocated for an industry partner?

A: Industry partners can be participating as an advisor, non-funded collaborator, providing samples or funded collaborator amongst others. Industry partnership and role should be shown in the proposal.

Q: From your viewpoint, what arrangement would be most favorable for your program in CT-3.1?

A: The AMMT program do not prescribed the manner of industry inclusion, therefore we do not provide a view on the arrangement.

Q: Are we focusing on property enhancement of current materials by using multi-materials configuration in CT-3.1? For example, improve steel's wear resistance by a metal-ceramic multi-material cladding.

A: We do not specify nor limit the material systems that you want to use to demonstrate your methodology. However keep in mind that the justification for your choices are an important part of the evaluation.

Q: Are we developing multi-material solutions to problems of wear, corrosion in CT-3.1? Or are we developing tools and techniques for structural characterization of structural integrity and residual stresses, with simultaneous property enhancement?

A: The second part of your question is the correct interpretation: “developing tools and techniques for structural characterization of structural integrity and residual stresses, with simultaneous property enhancement” . We do not specify which property enhancement, your multimaterial system choices and justifications are therefore important.

Q: Is CT-3.1 focusing of specific components of an advanced reactor system or design?

A: No, it should be agnostic to reactor type, it is an approach/methodology that is sought.

Q: Are there any specific materials of interest for CT-3.1? For example steel and titanium dissimilar metals structures? or any multi-material configuration with a justification be adequate?

A: Any multi-material configuration with a justification be adequate.

Q: Do the processes in CT-3.1 have to be applicable for every type of multi-material possibility: metals, metal-ceramic, composites, etc.?

A: Yes.

Q: On the requirement of two advanced manufacturing processes in CT-3.1: do these two processes yield the same multi-material structure or bring new possibilities but under the same characterization/enhancement framework?

A: The processes do not yield the same multi-material structure, but do bring new possibilities under the same characterization/enhancement framework.

Q: Should the research be designed to develop a coating/manufacturing process to address as a solution for all advanced reactors simultaneously in CT-3.1?

A: No, focus on the methodology/approach that can be applied irrespective of which material type it will be applied to.

Q: Should all material groups (Metal-metal; metal-ceramic; composites) be addressed in the proposal for CT-3.1?

A: Yes.

Q: What is meant by agnostic?

A: It means the approach is not specific tied to a material nor manufacturing process and can be applied for a range of coatings/gradient materials.

Q: What is meant by composite? Does this mean polymers?

A: Composites consist of two or more distinct materials, which together improve product performance; a material containing a matrix, or base substance, and a reinforcement material. This does not mean polymers.

Q: Does the experimental work to include the manufacture of a specific component?

A: No.

Q: For CT-3.2, the work scope description indicates the development of novel framework to investigate creep and being able to apply multi-material systems of interest. Do the multi-material systems mean: (a) weldments of dissimilar materials, gradient structures; or (b) other materials different from 316H such as ferritic steels, nickel alloys?

A: We are looking for multi-material systems, such as gradient structures.

Q: Are there specific alloys of interest in CT-3.2 program?

A: No specific alloys in mind, but, for examples, you could select any structural steel used in reactors.

Q: The CT-3.2 workscope reads "This call specifically encourages the submission of proposals using advanced additive manufacturing to build functional small-scale structures and graded features with in-situ mechanical testing and in-situ or ex-situ microscopy to understand fundamental creep deformation mechanisms of a given metallic structural material." What is the motivation of developing "functional small scale materials structures" for the creep study? Does a specific structure need to be built or can the focus be on bulk materials?

A: The goal is to develop novel approaches to assess time-dependent material phenomena with the FY23 focus on creep for a metallic structural nuclear material. We suggested small scale structures as path forward to develop these materials but graded and bulk materials can certainly be used. Our motivation for the use of small scale structures came from the recent successes with the design of zero CTE and zero Poisson ratio structures.

CT-4

Q: The ARS and Fuel Cycle MPact Programs are different?

A: Yes, the ARS (Advanced Reactor Safeguards) is focused on reactor facilities and the Fuel Cycle MPact program focuses on fuel cycle facilities.

Q: During the webinar, I noticed the HALEU MC&A and PPS is one of focused missions for the ARS program. So, I am wondering if the method of addressing the HALEU MC&A concerns will be considered within the interests of this year's CT-4 work scope? Please be noted in this regard, the focus would be working on the fuel instead of a specific advanced reactor.

A: Work on HALEU specifically will be moving to a lower priority in the ARS program. Our work from the past couple years has shown that the impact of going from Cat III to Cat II facilities is minimal for MC&A, and likely a low impact on physical protection as well. Also, the regulations seem to cover licensing of the use of HALEU well.

CT-5

Q: Would process measurements such as flow be of interest under the structural health monitoring umbrella?

A: I would say only if they can be successfully synced or successfully referred back to a method that entails structural health monitoring. In other words, the flow could be a measurement for structural health monitoring, but not in terms of just developing the sensor itself. So, measuring flow is not the target of the call this year. So, if an instrument that measure flow is necessary as part of the narrative to develop a measurement system for structural health monitoring, that's possible. But, again, it needs to be a complete package and the target needs to be structural health monitoring, including how that, then refers back to, as Dan mentioned, advantages in terms of easier maintenance, predictive maintenance, or efficiencies saving, in terms of the system. So, I don't know if that answers the question, but if it's just the flow meter or a new technology to measure flow, that's not part of the scope. If it's a flow meter that is part of the measurement system related to health monitoring then, yes.

Q: Would the development of innovative neutron sensors for power monitoring be a consideration or be of interest in CT-5?

A: It kind of relates to the previous question if that's in supportive of structural health monitoring then correct. If it's just a standalone neutron detector, then that wouldn't really fulfill the call for this year. Patrick, do you have anything else to add? No, I think that's appropriate. I know as far as flow is concerned, I could see possibly some connection, it being a piece. As far as the online monitoring itself, the way that I understand the question, I guess the answer there is more definitely not, in terms that we really wanted this year to have the cause focused on that. On one specific piece, structure is, of course a giant area and so there's enough scope there to justify having this as the scope of this call. Of course,

our arm controls and neutron flux sensors are of interest to CT-5, but, again, not of interest to the scope of the call this year.

Q: Does this work scope include sensors and instrumentation meant to monitor reactors for anti-proliferation or security purposes? Or is it focused exclusively on reactor health?

A: I would say that the sensors for proliferation or security related endeavors you would probably find a different scope area where that is more pertinent to under the cybersecurity program. I don't recall off the top of my mind what the number is for that specific scope area, but it should be close to this one. The sensors that are the scope need to be for reactor performance.

Q: Is it intended that the final feasibility demonstration occur at a reactor facility?

A: The way that we intend feasibility demonstration within a technology readiness level scale here is it reflects the technology readiness scale. So, feasibility means the very early stage of development. So, we don't need a demonstration in relevant operating conditions. To answer the question straight, no, it doesn't have to be demonstrated in the reactor. Feasibility means still laboratory testing. As part of the ASI program there will be then different mechanism which will take that technology to maturation through demonstration in the reactor.

Q: Do you have any examples of current sensors that are being implemented?

A: Implemented in the fuel cycles or in materials testing? Is that the question? I guess I'm asking for clarification. I think the question is trying to address whether there is technologies that we are already working on that could be applied to structural health monitoring. I'll just add, again, providing examples in this context is always dangerous so, I'll put all the disclaimers out. That doesn't mean that this is what we're looking after. There are two specific general categories, broad categories of technology that we're looking to apply for health monitoring. One of them is using optical fibers. The other one is using acoustic sensing. This is to provide general context. Now, these are used in industries, outside of nuclear, same function. So, it's not something that I'm inventing, but it's something that we are working on. Again, no exclusivity there. Anything else would work, just two examples.

Q: Can you define structural health monitoring for the purposes of this call?

A: I guess I could go and look at a textbook to provide a definition. So, structural health monitoring. What we mean here is measurement system and yes, as Dan recalled in the back. So we're looking for at the end of his last slide where we are targeting system that can provide real-time information on the health of components. As to maintenance schemes, like early fault detection, understanding things that are deteriorating in the performance of a reactor, so that can be preventive maintenance schemes and strategies can be applied. So, that's not a very accurate definition, or a broad one, but I think that's enough for understanding what we're discussing here.

Q: Would consideration be given to the monitoring of pumps and other power equipment, such as vibration, or spent fuel containers?

A: So, I think with the pumps that would I believe apply to the scope that we have defined here. We discussed how it relates to the primary or the secondary cooling loops. As for the spent fuel containers, I guess I would want to understand a little bit more what the person who asked the question is targeting there. But that doesn't immediately bring to mind any applicability for this scope specifically. Patrick,

would you like to comment? Well, I think you're right there. As Melissa mentioned before, for the cybersecurity portion, there's a large area. Many different sections of these calls are dedicated to fuel casks and spent fuel. So, this scenario that basically is dealt with elsewhere, so it's the publication is specific to fuel cask, then the answer is no. I echo what you said on pumps, that is part of the scope.

Q: Would a system that measures the shape of the reactor power profile for detection of flux tilts or hot channels, fall within the scope?

A: I'm not exactly sure how that would apply to the health of the reactor to the components and potentially detecting failure mechanisms. It's basically the same question as before, it remains the same. So, the second question answer is not.

Q: Are sensing approaches that monitor the temperature of structure internals of interest to this call?

A: I think it could be applicable, especially if there's significant temperature gradients that may cause thermal fatigue or failure of components. I think that could apply to this call. I think again, it needs to be stressed that it shouldn't be a measurement of temperature on its own. So, this is a package measurement system, and you would need to demonstrate in the proposal how that measurement then refers back to again, improvement either in maintenance or inefficiencies in terms of preventing failures and so forth. Really the focus should be the health monitoring part that needs to be a connection how temperature measurements are used towards that object, but it does make sense to measure temperature for that.

Q: Could a Digital Twin be recommended for demonstration?

A: I guess we hadn't considered that or disgusted previously. I would ask for a little bit more clarification from the person who submitted the question. What exactly do they mean by Digital Twin used for feasibility? Better if we come back to that question after clarification.

Q: It almost sounds like this call focuses on the health of infrastructure of SSCs as opposed to structural or civil structure health. Did I understand this correctly?

A: This is components. I can provide examples that we're targeting. Reactor components. Could be the health of built-ins, could be health of pump blades, the health of the vessel itself. I'm not sure I understand it. I don't think it has anything to do with infrastructure that we're talking about. Basically, reactor components or primary circuit components, secondary circuit components, heat exchanges, and so forth. Normally, term infrastructure is used differently. Again, I don't know if I answered your question, but if I didn't just because I'm not fully understanding the context.

Q: Does this call aim to monitor components like pumps, valves, or structure, like piping and tanks?

A: OK, maybe then I understand better the last question and both, so any of those. Those would be applicable to the scope.

Q: Is the scope of this call open for real-time gamma and/or neutron sensors inside spent fuel storage?

A: That's the answer earlier…those spent fuel systems are typically targeted under other scopes.

Q: The next question might be a clarification to a previous question. But with regarding structures, do you consider that to be containment too?

A: I believe that would also play a role. Containment, as in the concrete or the steel vessel, the primary vessel? I guess that would be another question. So, looking at the effect on the reactor. So, for containment, I would assume if it plays a role into failure mechanisms for the reactor vessel, then I would consider that as part of scope.

Q: Do the developed techniques need to work in-situ, for example, while the reactor is running, or are ex-situ monitoring techniques acceptable as well?

A: That actually would play into defining the range of operability in the proposals. We discussed that for proposals for the scope, defining what environment those sensors will operate in is necessary for the proposal. So, if someone was applying with a sensor idea that would operate only ex core and when the reactor is offline, then that would need to be included in the proposal. But I think both are applicable to this call. We tend to lean more towards each in-situ online, but that's not necessarily a limitation.

Q: To demonstrate the effectiveness of an instrument and implemented to measure, for example, a temperature across a pump during operation, then instead of placing the temperature in-situ at a reactor, could it be utilized in a Digital Twin to demonstrate the ability to model the temperature profile during varied operations as modeled by the Digital Twin?

A: This is a clarification to an earlier question. I think the consideration or the use of the demonstration through the Digital Twin, it could be part of the proposal. Again, the proposal stresses that the whole package needs to be demonstrated in terms of feasibility. We would want to see hardware as well. There's no reason why the demonstration portion, or when we discussed how that applies to then either maintenance schemes or to efficiency gains in the reactor operation that can be demonstrated through a Digital Twin. Yes, because we do not require here demonstration of the hardware in relevant conditions, such as a reactor. To answer the question, yes, the Digital Twin is an appropriate portion of what the proposal could be. Though again it needs to be stressed that the hardware is also an important portion. It has to be the hardware portion of what sensing element and what the sensor is interrogation and so forth.

Q: Would real-time detection of gamma fluxes at many locations within an operating reactor core fall under the scope? Possible health applications would be power measurement, ensuring that fuel assembly power and burnup as the models predicted, detecting coolant channel blockage, other anomalies that change power such as damaged or incorrectly located control rod.

A: It might be. It does kind of liken back to a question earlier where someone was asking about power peaking profiles. We're specifically targeting measuring certain components and their failure mechanisms. I could see how it could tie in. This is basically a continued clarification of the same question, so, I think the way that this clarification is going is that my "no" answer may be refined a little bit. If there is a clear tie to a power measurement, then referring back to the health of, in this case, that would be a fuel assembly, then I would say at this point, the way that this has been clarified, it shouldn't be discarded – a proposal could be considered. I would be stressing the fact that it has to be tied back to how it's applied for health monitoring rather than power control and power measurement, flux measurement.

FC-1.1: Nuclear Fuel Cycle Aqueous Separations Chemistry

(formerly FC-1.2 in the Webinar)

Q: You refer only to SX. Is ion exchange and immobilized ligands not relevant to this RFP?

A: Ion exchange can be part of the proposal, as it's part of the extraction process. We are targeting ligands in trying to simplify the process.

FC-1.2: Understanding, Predicting, and Optimizing the Physical Properties, Structure, and Dynamics of Molten Salts

&

FC-1.3: Understanding the Structure and Speciation at the Atomic and Molecular Scale

(formerly FC-1.3 & FC-1.4 in the Webinar)

Q: Would the measurement of thermophysical properties be limited to viscosity and heat capacity, or is thermal conductivity of interest too?

A: We are looking for innovation of all the properties, and not just in measurements but also the methodology.

Q: Could the experimental validation of models developed by the group be within the FC-1.2 workscope, or would this be better in FC-1.3?

A: It could be in either one if you do both equally with experiments and modeling, depending upon your proposal. However, FC-1.2 focuses more on the computational modeling and FC-1.3 focuses more on the experimentation.

Q: For FC-1.2, computational methods utilizing machine learning instead of AI/MD accepted as well?

A: Yes.

Q: What are acceptable concepts for FC-1.3?

A: As described in the call, we seek real-time spectroscopic and electrochemical methods to understand the effects of molten salt structure and dynamics on their physical and chemical properties. The goals are to determine the local structure and bonding of chemical species and to develop innovative real-time analytical methods for microscopic and macroscopic property measurements. We are not interested in studying salt in aqueous solution.

Q: We are interested in combining ab initio simulation, machine learning (ML), and x-ray absorption spectroscopy (XAS) to study metal ion (e.g., corrosion products, fission products) solvation structure and speciation in molten salt. We are interested in leveraging recent breakthroughs in ML and ML-based interpretation on XAS spectra. Do you think this would be of interest to the program?

A: It is preferable that each proposal may develop its own objective, technical scope, and R&D approaches based on literature data or PIs' previous results. Proposed scopes that rely on ongoing projects may complicate the review process.

Q: Are experiments required? Is it sufficient to use experimental data is that is already being generated by other projects / collaborations, or is there an expectation that some of the funds would be directly used for carrying out experiments?

A: Both salt topics are now limited at $400K per proposal. FC-1.2 is mostly for proposals with an emphasis on computation and modeling efforts while FC-1.3 is targeting proposals that focus on experimental activities.

<u>FC-1.4:</u> Iron Phosphate Process: Evaluation of Processing Parameters on the Product Properties

(formerly FC-1.5 in the Webinar)

Q: For this call, are modeling and simulation of interest?

A: Yes, if you have good idea, innovative idea, in doing this, we welcome that. I don't want to exclude that.

FC-2 (FC-2.1, FC-2.2 and FC-2.3)

Q: Regarding FC-2.1, what is the technical readiness level requirement?

A: I don't know that there is a requirement. I think in our world we have an affinity for things that have at least been demonstrated in the past with some level of proof of principle. I think that brand new, like, "I've never heard of this field designed before", things might be interesting. We might be a little hesitant on those. But I don't know. I don't think there's actually a real requirement. I think that this is a creative exercise, and I think that the risk and reward proposition needs to be balanced. If something is quite novel, indeed, then, you know, there would need to be a strong value proposition for it. Whereas if something were more mature and more of an evolutionary innovation, it would need to probably demonstrate that it's more likely to succeed. So that's a very vague answer, but I don't think there is a requirement.

Q: FC-2.2. Are there any DOE reports or review papers that can be read to understand the state of the art here?

A: I'm only aware of the SBIRs. You could contact the vendors and see what they're interested in, as showing a relevance is strongly encouraged, so that would be one way to look into it. As far as DOE reports, in my many decades, I'm sure we've thought about these. There are other programs, you know, in the past, NGNP, there's been gas reactors, etc. and certainly every program we had worries about control. But in this one, we're thinking of applicable to the current, existing concepts, primarily. I think just to follow up on that, I did a presentation at an EPRI meeting on some of the neutronics work on advanced control or in different materials for control rods and CRIEPI is interested in some of that as well. In addition to whom we've talked about contacting and partnership; that could include the NRC. It also could include EPRI. They have done a lot of thinking, as a matter of fact, even on the other items we discussed, you know, like cooling clad. I know that it's a priority consideration at EPRI. I just forgot to mention it. So, certainly, then they might also be a good contact.

Q: FC-2.2. Is this control rod project focused on modeling experiment, or is it better to combine both?

A: If possible, elements of both would be valuable.

Q: Is the focus of FC-2.3 on LWRs?

A: We're really open to acceleration of any new fuel concept of accelerating it and getting it licensed as fast as possible. If it's the accelerated fuel pulse methodology, I think that examples of opportunities to apply these kinds of techniques to ATF or LWR applications will certainly resonate with either one of our mainline programs. I wouldn't constrain it to that. I do think there's an advantage to that, to some of that route, though. But we would certainly entertain, good ideas in both advanced reactor and LWR. By the way, we can't go back in time and accelerate the qualification of existing ATFs that have already gone through that process. So, let's not waste time on that. There may be some advantage to doing a mixture of demonstrating methodology with known data, but I do think it's important to take forward looking, be forward looking, on how we would apply it to next-generation technologies.

Q: FC-2.3, Would any irradiation test to be encouraged, such as ion irradiation or neutron irradiation?

A: I think, in this particular case, this is a small project, so it's an $800K type of NEUP. So, it's probably beyond the means of the project to generate much new data. I think the emphasis should be on cases where we can identify existing data, use it to develop the methodologies for analysis of the data, as opposed to generating new data. There may be cases where there are small gaps or simple experiments that could be run to demonstrate principles. I wouldn't be against that, but I would rather see the emphasis placed on the methodology development and validation, over data generation. On the ion irradiation, on the state of the art of it, there's still a lot of certainty and the prototypic aspects of it. There's always that some region of your sample that's looking pretty good but then other regions…would there be any value in improving the data interpretation or confidence of an ion irradiated sample and scaling it to a neutron irradiation? That's exactly one of the places, I think, that there might be some opportunity here, is to use some of the scaling methodologies to identify the dominant physics and formerly connect those dots and see what things are working with ion irradiation and which things do we actually need neutron irradiation to capture. You have to show that you're improving because there is a lot of ion irradiation data and it's being used. The question is, is there a concept which we use it in a different way that would make it easier to use it as a scaling concept? So, it's a challenging area.

Q: FC-2.3 Would ion irradiation experiments be considered as a possible source of accelerated irradiation data?

A: Yes. I think it's possible that ion irradiations could be used in that way. I think that the goal here is the mathematical connection between those two things. I would not be interested in ion irradiations being funded under this project. I think it would be studying the relationship between neutron and ion irradiations, to try to quantify the connection between the two. It already is an excellent example of an acceleration concepts. But its use is difficult. So, if something would show how to make it easier or faster or more accurately to use, that might be a question, but clearly, it's a field that's already heavily investigated and used.

Q: FC-2.3. Would a project focused on modeling and processing existing data, with no new experiments, would that be considered?

A: Yes, that's very much what we're looking for. If you have existing data and we can use these tools to assess the relationship between datasets, that that would be ideal. These types of tools are great for pursuing validation of models and also extrapolation of data and models. So, I think that's a pretty good fit.

Q: For FC-2.2, can you share some points of contact from industrial partners that are interested in accident tolerant fuel rods?

A: We have done very little in the area of Accident Control Rods under the DOE AFC program. There is work going on at CRIEPI under H. Ohta – if you Google "Accident Tolerant Control Rods" you'll find reports on some of his work and more. The contacts for the ATF FOAs that I am aware of are: Framatome: Jeff Reed GE: Russ Fawcett Westinghouse: Ed. Lahoda Additional resources: https://nuclearfuel.inl.gov/afp/AFC%20Accomplishments%20Reports/AFC%202019%20Accomplishments%20Report.pdf

FC-3

Q: Is modeling and simulation of interest and if so, what level of theory are you looking for?

A: Yes, it's of interest. Generally speaking, due to a limited number of awards being available, the interest is more in sensor development, but that doesn't mean that modeling would not be of interest for a systems engineering or modeling study. The types of models we are looking at tend to take different platforms and integrate them together using systems engineering. It's definitely not really first principle or not modeling early in the development stage, we are looking more for an applied modeling approach for a system or facility.

Q: Is this workscope for 2 years at $400K or 3 years at $600K?

A: It is for 2 years at $400K.

Q: Are you mostly interested in uranium inventory or are you also interested in fission product accountancy?

A: We are interested in both. Pu and U are the most relevant, but anything spent fuel, fission products and actinide measurements in general especially in real time are of interest. In the front end of the fuel cycle in general, for fuel you are talking being focused on U or fresh fuel will involve U.

Q: Are you interested in experimental approaches only, or are you interested in incorporating modeling and experiments?

A: We would encourage you to combine the two, though it can be tricky in terms of how the application is written. I would encourage you to be very specific about when the modeling starts and stops how the results are going to help with your system or detector design.

Q: Is there a particular interest in any particular modeling tool? Such as something in the VERA or MOOSE suite?

A: There are some codes at national labs that are more detector focused. I would encourage you to use whatever you are comfortable with as long as it is relevant to your proposal. We would not judge a proposal more harshly depending on what code you used, as long as you are using one that is relevant to your project.

Q: Could you also propose a new simulation platform to be used for a project?

A: Yes, I would not rule that out. I am a little more cautious with lower TRL and newer things being developed and have an eye on projects that can be completed within the NEUP funding timeframe. We are open to it, and it could be a good idea, but I'm cautious about funding very unknown or experimental models because of the applied approach and limited number of awards available each year.

Q: When you mention materials protection, do you mean replacing with new materials or do you mean protecting the ongoing materials with some sort of coating or deposition?

A: In a facility, it's about protecting, accounting for, and controlling the materials – more of what the regulators are looking for, not a coating on a material.

Q: Is the focus of this topic solely on applications of emerging fuel cycle?

A: That's a tricky question. Yes, we are primarily focused on technologies that at least can be used on emerging fuel cycles. There aren't advanced fuel cycles, per se. A lot of our projects could be dual use technologies. As long as you demonstrate improved safeguards and/or securities for an advanced reactor fuel cycle facility or a bulk material processing facility, a molten salt loop, or some kind of aqueous or pyro processing facility, etc., it's a gray area. We do ask in the proposal that it can be used for emerging or advanced fuel cycles.

FC-4.1

Q: Where do we send questions in this workscope?

A: Please send questions to neup@inl.gov.

Q: Does the US have any transported or disposed spent nuclear fuel?

A: The utilities transport spent fuel from their production sites to their storage sites. The US government has done limited transportation. I cannot think of an example of where any long-term disposal of spent nuclear fuel has taken place.

Q: Is collaboration with industry allowed in this workscope?

A: Yes, collaboration with industry is allowed and encouraged.

Q: Pit and crack propagation rates – is this topic part of FC-4.1 and 4.2 or 4.3 with uncertainty analysis?

A: It is not part of any of the calls this year. This was a topic in past years. In FY22, FC-4.1 deals with disposal of the waste, while pit and crack involves degradation of the waste canister.

Q: Would ceramic waste forms (e.g. immobilization of Pu) be of interest or are just projects about SNF of interest (FC-4.1)?

A: Waste form development is not within the scope FC-4.1. The focus is on commercial SNF.

Q: Is the focus of this call on geological buffer materials or would engineered waste containment designs for long-term waste disposition also be considered in this workscope? Will proposal for development of novel neutron/gamma detectors for continuous monitoring of spent fuel for integrity assessment purposed be considered under FC-4.1?

A: Detailed containment designs are not part of the current scope. Geologic buffer materials are within the scope. The focus is on generic geologic repository media and environments. Novel gamma/neutron detectors are not withing the scope of FC-4.1.

Q: Would DOE still be interested in deep borehole activities such as designing packages capable of holding consolidated SNF while withstanding potential drops into and the geochemistry conditions of the deep borehole and optimized for handling and retrievability operations (FC-4.1)?

A: Current activities do not include deep borehole disposal activities.

Q: Would a research proposal supporting the direct disposal of dual-purpose canisters be of interest in FC-4.1?

A: Yes.

Q: Which type of waste form would be of interest in FC-4.1, with which type of used fuel and what type of disposal environment would you be interested in?

A: The waste form is commercial nuclear spent fuel in geologic media, saturated or unsaturated.

Q: As part of maintaining SNF retrievability, would the design of facilities for the repackaging of SNF be covered by FC-4.1?

A: FC-4.1 does not cover surface facilities or repackaging.

Q: Is there interest on modeling and simulation research on glass waste forms in FC-4.1?

A: The focus of FC-4.1 is on commercial SNF.

Q: Is the focus of FC-4.1 on commercial LWR SNF or could DOE-owned SNF also be part of the scope?

A: The focus is on commercial LWR SNF and not DOE-owned SNF.

Q: For FC-4.1, Is research proposal to support direct disposal of dual purpose canister of interest?

A: Yes.

Q: For FC-4.1, Is the focus of this call on geological buffer materials or would engineered waste containment designs for long-term waste disposition also be considered in this work-scope?

A: Focus to date has been on geologic buffer materials. Any new engineered waste containment designs may be considered as long as the designs support the performance in generic geologic media outlined in FC-4.1.

Q: For FC-4.1, which type of waste form will you be interested, with which type of used fuel, and what disposal environment will you be interested?

A: Spent Fuel (SF) is the primary form of waste being considered. The environment could be saturated/reduced or unsaturated/oxidizing.

Q: Will proposals for development of novel neutron/gamma detectors for continuous monitoring of spent fuel for integrity-assessment purposes be considered under FC-4.1?

A: FC-4.1 does not address instrumentation development for monitoring.

FC-4.2

Q: Would there be more information on the physical test set ups with the FOA in FC-4.2? At what point can we reach out for more information?

A: Yes, we have more information on this topic, and that can be provided. Once awards are made, this information will be provided to the awardees. There is a lot of data provided in the FOA, and the draft workscopes have been issued with that information. If other information is available, it will be posted publicly for all to see.

Q: The draft work scope explicitly mentions shake table testing at the soon-to-be upgraded UC San Diego outdoor shake table, so is this expected to be part of the proposal that PIs coordinate and conduct the tests at UCSD and budget such tests or these tests are already planned through DOE and PIs are only participating in data analysis?

A: No. Coordinating and conducting the tests at UCSD is not a part of the proposal.

Q: Are there certain researchers (for example professors at UCSD) that have to be part of any proposal to allow for the testing or anyone with large-scale and shake table testing expertise can qualify to lead the proposal?

A: No. UCSD does not have to be a part of the proposal. The major task of the proposal is to evaluate and process (including modeling) the data collected during the test.

Q: What are the options of using other shake table facilities?

A: No. The test unit weight is 450,000 lbs. The UCSD facility is the only facility in US that can handle this weigh and provide 6 degree of freedom shaking. The agreement has already been made with UCSD to conduct the test. Other shake table facilities can be used later if the data analysis shows that more tests are needed and that it is adequate to use a part of the system (~1,600 lbs surrogate assembly) instead of the whole system (~450,000 lbs - cask, canister, and 32 assemblies).

Q: This workscope is very focused on data analysis and computational modeling of seismic behavior. Is there any interest in also funding some analysis of the subsequent impact on the neutronic or heat production characteristics of assemblies that have experienced these seismic events?

A: No. That is outside the scope of the topic.

Q: The work scope description in FC 4.2 states "the total weight of the test units in either configuration is greater than 300,000 lbs." A publication about the UCSD shake table (Table 1 in https://doi.org/10.1002/eqe.3510, reference [13] in the pre-application) states that the table mass is 144000kg (~317000 lb), comparable to the weight of the test units indicated in the FOA. I wanted to check if it might be possible to get some clarification on whether the test units weigh in the order of 300,000lb, so that their weight is similar to the table platform or understand if this is not the case.

A: For the mass of the tested configuration, our final test plan (Seismic Shake Table Test Plan, Milestone Number M3SF-21SN010202023, SAND2021-11207 R; https://www.osti.gov/biblio/1821972-seismic-shake-table-test-plan) report indicates:

“The test will be conducted in the vertical configuration. The loaded NUHOMS 32 PTH2 canister will be placed in a vertical cask. The simplified cask will be manufactured. If budget permits, the test will also be conducted in a horizontal configuration using an Advanced Horizontal Storage Module (AHSM). The weight of the loaded NUHOMS 32 PTH2 canister will be ~106,000 lbs (48,080.79 kg). The total weight of the loaded vertical cask will be 324,645 lbs (147,256 kg).”

So that the vertical cask to be used in the test is ~325,000 lbs (~ 147,300 kg).

From what I understand of the LHPOST6 platen mass is in this range or slightly higher.

FC-4.3

Q: For FC-4.3, is there any specific code should be used to compare the experimental data regarding particle transportation and so on?

A: We are looking for the awardee to make the selection themselves. We want the empirical data from the awarded and use it in existing codes. So, we are looking more for the empirical data.

Q: Small scale experiments are encouraged in this workscope. Can you give an example of the small-scale experiments being looked for?

A: We are looking for the awardee to develop the lab experiments to generate the data for the ten mechanisms mentioned in the workscope description.

Q: What is the size of the horizontal and vertical storages, including the canister, overpack, and the gap between canister and overpack? How are the air inlets and outlets distributed on the overpack? A drawing that shows the configuration details will assist us on the experiment design, so if you have it would you indicate where to download it?

A: See below for publicly available information on vertical and horizontal canister designs (Question 1). Due to the proprietary nature of this information, certain details are redacted. The sources listed below provide some of the best available geometric information on these systems. MAGNASTOR (Vertical): https://www.nrc.gov/docs/ML1024/ML102420568.pdf NUHOMS (Horizontal):
https://www.nrc.gov/docs/ML0510/ML051040569.pdf
https://www.nrc.gov/docs/ML0415/ML041540170.pdf
https://www.nrc.gov/docs/ML0632/ML063200211.pdf

Q: What particle/aerosol are you interested? We think it could be dust, sea salt, NaCl, and many others—do you have a preference among the various species?

A: Listed are two studies that recently studied depositions on canisters (Question 2). These studies provide details on chemical species of interest and some size information. ISFSI Dust Sampling: https://www.osti.gov/servlets/purl/1738872 https://www.osti.gov/servlets/purl/1174230

Q: We cannot find the references [1][2][4] online as mentioned in the work scope. Would you indicate where to download? (They are: [1] Jensen et al. Preliminary Deposition Modeling: For Determining the Deposition of Corrosive Contaminants on SNF Canisters. PNNL-2960. January 24, 2020. [2] Jensen et al. Status Update: Deposition Modeling for SNF Canister CISCC. PNNL-30793. December 18, 2020. [4] Schaller et al., FY20 Status Report: SNF Interim Storage Canister Corrosion and Surface Environment Investigations. SAND20-12663 R, November 11, 2020.)

A: We are looking for the awardee to develop the lab experiments to generate the data for the ten For question 3, all references are now in OSTI: Jensen et al. https://www.osti.gov/biblio/1814640-preliminary-deposition-modeling-determining-deposition-corrosive-contaminants-snf-canisters Jensen et al. https://www.osti.gov/biblio/1814639-status-update-deposition-modeling-snf-canister-ciscc Schaller et al. https://www.osti.gov/biblio/1718972-fy20-status-report-snf-interim-storage-canister-corrosion-surface-environment-investigations

FC-5: Accelerated Fast Reactor Metal Fuel Cladding Material Development

(formerly FC-5.1 in the Webinar)

Q: Would high entropy alloys be considered a new cladding concept?

A: Yes. Definitely. That's a new alloy concept, so that would fit in here.

Q: Would you be interested in additive manufactured steels or additive manufacturing?

A: Yes. We would be interested in it if it does produce a material that has improved radiation tolerance over the present alloys or HT-9 made in the rot form. Also, you need to be able to use it to make a cladding tube so it can be applied to make it in the shape that we need and make some more radiation tolerant material.

Q: Would high entropy alloys be considered a new cladding concept?

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Q: Would FC-5 be interested in an additive manufactured steel, or additive manufacturing?

A: Yes, we would be interested in it if it does produce a material that has improved radiation tolerance over the present alloys, or HT-9 made in the rot form. You need to be able to use it to make a cladding tube. It can be applied to make it into the shape we need and make some more radiation tolerant material, yes.

Q: Why is sodium bonding considered a negative in the fuel form?

A: It's just in waste handling. If there's some storage or waste storage situations where the chemically reactive state of the sodium is undesirable for the waste form. If you're talking advanced fuel where you're recycling it, it's not really a problem. The reprocessors can handle disassembling the fuel and managing the sodium. It's a waste form issue if you're going to have once-through fuel. There are some near-term fast reactor concepts; the Versatile Test Reactor, for example, our experimental reactor, as well as some demonstrations that do want to go once-through, just use their fast reactor fuel once. Having sodium in them would complicate what we do with the fuel once they're done using it for power. Also, when you make the fuel pins, it's an extra step that sometimes can take time. A slug of sodium is entered in, it has to be liquefied, then one has to make sure, by quality control, that it fills up the space and there are no bubbles or gaps. So, even though it works very well for the purpose of what it's supposed to do, it would be interesting if we can do away with it.

Q: Do you have any examples on coatings and liners?

A: If we're talking about for fast reactor type applications, if you're integrating a coating into a cladding, there's been quite a bit of R&D looking at, or at least conceptual R&D, looking at different coating materials or liner materials; zirconium and vanadium have been the ones that are most commonly referred to. I think the material choices are not too challenging. I think one of the major questions we

have is about application and quality control and the relationship with steels and so forth. There are present ideas already that we're looking at already. We're using a zirconium liner, or using titanium nitride liner, or something like that. Something that prevents fuel clad chemical interaction with something like HT-9, so that you can go to much higher burnout that we would need for the fast reactor applications. This would be one of the areas where it would be very important to try to check in with the experts at the labs who know what's been done. There has been over many years work on this done. It's certainly open for advanced work, but, it's good to get the background on this if you're going to show, as previously mentioned, you've got to show an improvement that you're going to come out with something that's better than what we got or considering.

Q: Would shaping and fabrication of ODS cladding, as well as micro-structure processing of ODS, to improve their properties? Would that be of interest?

A: It would be of interest, once again, if it's going to improve the method of processing it into a thin-walled tube form. One of the difficulties with ODS alloys is that they are so strong with the fine oxide dispersion that it's the processing of it into a thin-wall tube form is difficult, especially to the long lengths you need for cladding applications. So, if that shaping technology helps you get there better than say, pilger processing, which is one of the leading technologies now, for ODS steels, yes, that would be applicable to this call.

Q: What kind of TRL is needed for the materials?

A: There are a range of TRLs that we will be looking at for these materials. If you are enhancing, forged martensitic steel, or enhancing an ODS deal, then you may be at the higher TRL levels, 4 to 5, but, if you're just proposing a novel, new concept, that may be at the lower TRL 2 to 3 level. I think it really depends on what the concept is you're proposing as to what TRL level it is. I think one of the key things is to be cognizant of the TRL level your concept is at when you make a proposal and to be addressing the kinds of questions that are appropriate for that TRL level. We certainly don't want someone to dial in on one phenomena of fuel. We want the proposer to be aware of the full life cycle demands of this cladding; getting the material, can you find it in nature, manufacturing it to the shape as previously pointed out, shaping normal operating conditions, the chemistry. We don't want someone to say, "this one phenomenon of cracking in this situation… this will address it." Make sure that what you're proposing, you're considering a full life cycle; that you've demonstrated you understand the full environment that this cladding is going to be in and that you've considered, that at least it with the information available, it's viable in all aspects of the life of the cladding.

Q: Would there be any interest in including modeling or is the focus purely on experimental based proposals?

A: The focus is mostly, in this case, on experimental based proposals. I think for these proposals, I don't see significant addition of modeling to that would help.

Q: Would you request to perform experimental tests to meet the three design conditions, particularly high dose irradiation tests?

A: I wouldn't say you have to meet all the three design conditions. Particularly, the higher dose is the one that you want to aim for these new material concepts are improvements in material alloys. Of course, the only way you're going to be able to do that is through ion irradiation. If you go back to the

other questions, but in this case, to those such high doses you're not going to get there with reactor radiation, not on these proposals.

Q: For the processing method to apply cladding are we seeking for a technique to lower the cost?

A: If it is related to FC-5, no. We're not looking for cost savings here. If it's related to accident tolerant fuels, again, it would have to be relevant to something that's existing. If someone is proposing additive manufacturing for cladding, that has the potential of being really slow and costly. So there, if additive manufacturing is pushed, the reality, could you really make a lot of cladding with this thing in a realistic time should be addressed. So, in that subset of information, I would say, cost would be important. The main thing we're aiming for is showing material that has improved radiation tolerance under these design conditions, so, that happens to be more expensive to make that material, that isn't as much of the issue as being able to actually address these challenging conditions. I kind of retract my statement because ODS is such a promising thing and it seems to be really hard to make, so, good points. We can make a breakthrough and have a cladding shape and ODS that works well. Forget the cost for a while, let's play with this and see what we got and then we'll address the cost, right? Yes.

Q: Why is the temperature of 700 degrees Celsius plus prescribed?

A: I think the only reason why we pointed out being able to go to even higher temperatures is for a more efficient reactor applications. For the main application, the maximum temperature is not going to get, for example, a sodium cooled fast reactor is not going to get to much higher than 700 C just because designing a reactor to such high temperatures is extremely challenging. I guess what we're trying to say here is that improved properties, at higher temperatures is an advantage we're looking for. Take HT-9 for example. It has significant reduction in mechanical properties as well as creep strength at high temperatures above 600 degrees C. A material that actually shows some improvement in that temperature range is one that we would be looking toward if it also meets some of the other requirements, such as the high dose requirements needed for this application.

Q: For the Advanced Fuels topics, is a novel manufacturing method for TRISO fuels of interest?

A: I think pull that out because we say accident tolerant fuels. It is in its own way certainly an accident tolerant fuel. We're talking about the accident tolerant fuel program with the existing three vendors. It's a fascinating question, because clearly it is, but, I would exclude it from consideration in these NEUPs.

Q: While designing a new cladding, are there any particular targeted properties prescribed? For example, creep segregation and corrosion?

A: I'd just go back to sort of the last part of the areas to addressing in your proposal. I think you want to look at the present gaps for the leading materials. Creating martensitic steels or oxide dispersion strength and steels and then address those in your proposal. I'm not saying that I'm aiming for one or the other, whether it's segregation, swelling or something like that. I think that you look at the gaps that you have for using a material, like the present HT-9 out 300 DPA and address that in improving that material so that you have a better material to be used in those conditions.

Q: Will atomistic-to-mesoscale computer simulations with an aim of mapping the fine-scale mechanisms to your macroscale experimental observations fall into the scope of this area?

A: The FC-5 category in NEUP is predominantly experimental. So, if modeling calculations would be led by experimental work, that could possibly fit the topic area.

Q: Do you have any report or slides on Fuel cladding tube development?

A: See the following article: https://www.osti.gov/pages/biblio/1716824

Q: I am writing for your comments and insights on possible NEUP FC-5 topics: (1) Studying and evaluating high-entropy ceramics as new cladding materials for increasingly extreme conditions as described in the draft FY 2022 Work Scope and (2) how to tailor elemental variation to overcome brittleness of ceramics. Is one (or both of the ideas) of interest?

A: Both sound interesting as long as you can show that the materials can be made into engineering form (e.g. thin walled tube for cladding). The second seems most interesting of the two.

Q: Regarding FC-5, I am wondering if the high temperature helium embrittlement effect would be an interesting point. In my opinion, although the helium production rate in FM based steel is low in fast reactor, 300-400 dpa still can accumulate ~30-40 appm He if assuming 0.1 appm He/dpa rate. Considering the high irradiation temperatures (700C or above), high temperature helium embrittlement may be the primary issue at such high dose and temperature conditions.

A: The scope of work was modified in the final FOA to say up to 700C instead of 700C and above. Also with the low amount of He produced in a fast reactor, He embrittlement is an issue but not the major issue.

IRP-MS-1

Q: Would an analysis and critique of nuclear engineering curricula as well as a study of why individuals leave the nuclear engineering field be appropriate for this work scope? The goal of this part of the analysis would be to inform how NE as a discipline needs to reinvent itself in order to attract new students and demographics.

A: Although I think that could be an aspect of this scope, what we are really looking for with the budget we have for this area, is a more comprehensive analysis of the overall workforce. The ask here is broader than being able to provide comprehensive data or projections or other things like that, that could predict existing or emerging needs.

Q: Is this a technical work scope?

A: This is a work scope that is technical with a focus on the social sciences. It will take an understanding of the current state of the nuclear energy environment and also an exploration of several social science topics to explore the gap analysis we are looking for.

Q: Would the department of energy be interested in an international dimension for this analysis? For example, workforce gaps in new nuclear countries.

A: This work scope is focused on domestic workforce gaps.

Q: Are the goals and objectives of this work scope to support nuclear engineering graduate students participating in a proposed workforce development plan or to develop the workforce development plan only?

A: Projects are intended to produce a research-informed workforce development plan. Graduate students may be used to perform research activities related to the development of the plan including but not limited to economic modeling, workforce development modeling, statistical analysis, etc.

IRP-MS-2

Q: Would there be interest in studying and developing methodologies for siting nuclear facilities in participatory and inclusive ways? These methodologies would have broad applicability beyond waste facilities.

A: We're looking for input into our consent-based siting process, but that could be very relevant, obviously there are some things that are unique to nuclear waste siting. Certainly, many of the problems that we're facing are not unique to nuclear waste, so, maybe.

Q: Seeing how industry appears to have successfully licensed CISF, Will input from these facilities be beneficial to this activity?

A: Possibly, but not from necessarily from a technical perspective of how they are successfully managing consolidated interim storage facilities on the site. We're not looking for input into the technical aspects of managing the waste, we're looking for input into a consent based voting process from a social aspect.

Q: Does the goal of this IRP include identifying specific sites?

A: No. The Department of Energy would have to manage the siting process itself, but this would be supportive to the work that we're doing to identify a site.

Q: Is this consent based citing activity limited to a consolidated interim storage facility or a repository as well?

A: So right now, we're focused on a consolidated interim storage facility but the work that is being done under this scope would be applicable to the siting of the repository as well.

Q: Could the scope include how engineering and technical aspects of a facility could influence consent from a community?

A: Yes.

Q: In what timeline do you expect this consent-based siting to take place?

A: This particular award is up to three years, but, obviously, consent-based siting itself will take much longer than that, but we are interested in this scope to inform some of the early-stage work that we're doing.

Q: Is the IRP work scope statement IRP-MS-2: Consent-Based Siting limited to applications on the process for siting spent nuclear fuel (SNF) or High-Level Waste (HLW) facilities or are applications acceptable that look at the consent-based process for siting any nuclear facility including commercial reactors? Would an application that evaluates the consent-based siting process with a microreactor as a test case be considered acceptable under this IRP work scope?

A: The work scope for IRP-MS-2: Consent-Based Siting is focused specifically on consent-based siting of an interim storage facility for spent nuclear fuel. Research outcomes could inform efforts to site other facilities, including other waste management facilities or reactor technologies, but this work should look specifically at integrating principles of environmental justice and equity into the consent-based siting

process for a consolidated interim storage facility. Part of the scope could include reviewing siting of other facilities and technologies as case studies.

IRP-NEAMS-1

Q: Should this corrosion study be specific to molten salts?

A: Yes, and the variance of molten salts can differ. It needs to be specific to molten salts.

Q: What is the expected balance between modeling and experiments?

A: I don't know that we necessarily want to prescribe that balance. I think the call states that there's an openness to both experiments and modeling and simulation. Just to re-iterate this is really a collaborative effort in a programmatic sense between the MSR campaign and the NEAMS mod-sim program. So, the expectation is that proposals will include both modeling and simulation and experiments, and I think it's up to the proposers to determine what the right balance would be. I would also add that the relationship to experiments and modeling is, it can be put in two different ways. You can use experiments to do predictive modeling, and then, or you can do modeling to do predictive experiments. Both of those are acceptable. You just need that proposal needs to be clear and what path, and what would be the benefits one to the other. I will tell you that we are looking for both having something that is just down on a model without experiments is going to be kind of an issue, because we want to be able to mature the MSR program and we find that having both of those to be very valuable.

Q: Is there a preference as to chloride or fluoride salts?

A: There is not a preference. They do, depending on if you're how you're using the fluoride and the chlorides in fast or thermal applications. There are benefits from one to the other. But we don't have a preference. It depends on what the proposal recommends coming to the table. The only thing I might add is that the impurities might be somewhat different, obviously when talking about fluoride. If the proposal was to focus on either fluorides or chlorides it might be that the set of impurities would be necessarily different. But now there's not a stated preference between which halide is the focus. At least the scope as written currently, which could change I think that's a disclaimer on any of the scopes in the current CINR draft, so pay attention to what gets made in the end. But the way this is currently drafted, we do have a statement that says, Industry partnership is required as part of this, this IRP, so that should be factored in as well.

Q: Should the corrosion effort also have a focus on the impact of fission products and impurities?

A: I don't want to be too prescriptive, but I think that a compelling proposal would do a good job of linking those two concepts. I wouldn't go so far as to say it's mandatory, but I think it would be very interesting to see if there were impacts of certain impurities, whether it's a fission product or something else on corrosion rates and mechanisms.

Q: Could investigating corrosion in salt under irradiation conditions be a consideration here?

A: Absolutely. Yes. Our reason for not making it too specific is that we're trying to make a broader call, but that is certainly something that would be acceptable.

Q: Would surrogate impurities make the experiments easier to be a consideration?

A: I would say it depends. If a compelling case could be made, I mean, obviously, experimentally, some of the fission products or actinides of interest might be very difficult, if not impossible to consider and especially in a university setting. So, if a surrogate was to be proposed, I guess my recommendation would be to make a very compelling case for the selection of that surrogate, and make sure that it was translatable to the actual impurity. I would add that, yes, there's nothing wrong with using surrogates. I think the application, to Dave's point earlier, more specific to commercialization, would be the issue. So, if somebody is going to use a surrogate, having it mature into maybe a space where it can advance, mature to support commercialization beyond just using a surrogate would be something I would look into. But, yes, surrogates are all perfectly fine right now. It's just that once you start working towards commercialization that's gone to minimize the advantages that is necessary.

Q: What percentage of experiment vs modeling? Would this be experiment or modeling dominated?

A: Generally, NE is interested in what the proposal teams view as the right split for the work they propose. While there may not be an equal division of experimental work versus modeling, NE is interested in two potential avenues; predictive modeling to assist experiments and/or how can experiments assist in developing models. NE has left the division of experiment versus modeling to the applicant since we cannot anticipate capabilities or resources.

IRP-RC-1

Q: Is this only focused on conventional fusion bonded materials or is it open for new technologies for fusion bonding which are possibly better?

A: The materials we are interested in are ones that have been qualified for nuclear applications as well as some that are ongoing qualification. Yes, in terms of diffusion bonding processes, new methodologies that can effectively help us solve these problems are within the scope. There will need to be the possibility of upscaling the technology to industrial scale.

Q: Does the application require both experimental and computational activities?

A: Yes, because one of the goals is to come up with some predictive methodology to come up with an understanding with the properties and microstructure relationship in order for someone to be able to reduce the cycle of diffusion bonding parameters and then do the testing and then go back through the process again. This will augment the current state-of-the-art process by the industry.

Q: Are you interested in developing a code case for contact heat exchangers?

A: We are interested in a code case for the current acceptance criteria. Right now, the code case is ASME is to just suffer through the process qualification and specs of metal sheets and then for examples you do pencil test. We found out the pencil tests were not discriminate enough to rule out some failures. We are looking for good acceptance criteria for microstructure or some mechanical property testing so that a diffusion process can pass the acceptance criteria and so we have the confidence that the failures will not occur.

Q: Would it be possible to use new materials that have not been approved by ASME at the moment?

A: That is somewhat difficult. If you pick a material like that works like 316 L grade, works well with similar chemistry, but had diffusion bonding process had difficulties. We would like the project to help us to do diffusion bonding in nuclear applications. We are looking to use technology in the short term, which means using alloys that are already been accepted in the code case.

Q: Do you foresee any need for thermal hydraulic studies with this IRP?

A: Only to the extent that thermal hydraulics will help us to understand the diffusion bonding process.

Q: Are there any other bonding techniques that are welcomed besides diffusion bonding?

A: We are open to innovation in how the sheets of metal are bonded together. The currently the process that is used is diffusion bonding and we would be open to innovative methods of diffusion bonding.

Q: Would you be interested in using NDE methods as part of developing the ASME code case criteria?

A: Yes, we'd be open to that if it's not too burdensome and time consuming.

Q: Is environmental testing of mechanical properties of advanced reactor coolants of interest in this call?

A: No, that is outside this particular IRP. Our goal is to make the results of this IRP applicable to as many reactor types as possible, that's why we are not focusing on any one reactor type.

Q: Is the functionally graded material fabricated by additive manufacturing of interest in this IRP?

A: We want to support near-term deployment and since those processes are not adopted by the regulator or the ASME, so therefore it would be difficult for us to use that type of material for a licensed application. This would be good for further discussion in the future.

Q: What if a material is listed in another section of ASME but not approved in Section 3, would that be acceptable?

A: No. We are looking at deploying this technology as quickly as possible, so we'd like to focus on the alloys that are already approved.

IRP-RC-2

Q: Could you elaborate on some of the perceived potential barriers to commercial deployment in the context of TRISO fuel?

A: Some barriers are dependent on the design for ways to be used in contact form or pebble form and it's up to the developer to address gaps with the regulator. Right now, we are compiling the remaining data that is available. It depends on how different your fuel would be from what they have made in the TRISO program. It was recommended to look at recent topical report that the NRC has approves on ATR-1 and ATR-2 data that includes specifications on the TRISO fuel performance.

Q: Is modeling using molecular dynamic is part of the scope?

A: Yes, we could be looking for modeling as part of the scope, please provide details in your proposals.

Q: Is there funding for developing experimental and/or computational study for safety studies of Gas cooled reactors focusing on thermal hydraulics?

A: This year's focus is not in that area. The pebbles and graphite are the focus this year for the IRP.

Q: For IRP-RC-2 are only proposals that include the graphite waste issues of interest or are topics that are focused on the TRISO uranium reprocessing only also of interest?

A: This IRP is focused on graphite fuels right now.

Q: Is the topic of defueled graphite block disposal included in IRP-RC-2?

A: Yes.

<u>IRP-RC-3:</u> Developing the Technical Basis and Risk Assessment Tools for Flexible Plant Operation

(formerly called *Light Water Reactor Sustainability* in the Webinar)

Q: Is maintenance optimization part of this IRP?

A: It could be important to a proposal though the maintenance is not part of the work scope. Maintenance should be considered as part of the whole complex design system.

Q: Does a proposal need to cover all the four focuses, or just include one or more?

A: Overall, all of the applications together should cover all four of the focuses, but each partner could only cover a part of it. Matching the scope of work to the detail is important for the funding provided. It is expected that more than one focus would be covered in the proposal.

Q: Will the electrical grid/microgrid also be covered in this call?

A: The emphasis here is really on the plant.

MS-NE-1 & MS-NE-2

Q: Can either analytical or experimental benchmarks be considered for MS-NE-1, or do we need an integration of both of them?

A: The simplest way to answer would be to say if we haven't specified in the call, which I don't think we have, then, no. Either could be proposed. I guess I would say in your proposal it's important to very clearly identify the advance that's being made. The importance of the proposed work. The impact of the proposed work. I think there can be some analytical benchmarks that you can demonstrate that case as well. Just make the best case that you can and to agree you can quantify or even make qualified statements about what currently can or cannot be done and how this would impact that.

Q: Is the focus for data on transient analysis only?

A: No, I just note that as an area that we've been seeing increased interest in.

Q: Is there an interest in the development of improvements to the nuclear formats to improve their ability to be used in modeling and simulation tools?

A: The way the question is worded. Yes. There's an interest. Whether falls within the scope of this call or not, I think an argument could be made. At the same time, something that broad, I would really prefer to see addressed in a broader fashion, such as the inter-agency FOA, a lab call that the Office of Science puts out. I think addressing something in that forum would be a better place to do so. But again, the scope statement says what the scope statement says, and if you can fit it in there, then you can propose it. Just make the best case as to how you're going to do it and the impact that particular proposed scope would have. I say that kind of from the standpoint of, again, doing it in this forum under this FOA, as opposed to something broader. If we're going to do it here, how are you going to impact that larger community? Because we're not only talking about multiple entities and institutions within the United States, in that case, where we're really talking about the international community.

Q: Is there any interest in improved photo nuclear data under MS-NE-2?

A: I'm afraid I'll start to sound like a broken record. It could be. It's allowed under the call. I don't see anything that prohibits it. I think it’s just important to make the case on who needs it, what it's hindering currently, and what the proposed scope, you know, the impact that would have on particularly industry being able to deploy something.

NEAMS 1-2

Q: Are you considering reduced order methods or just lower order methods like SPN, corrected diffusion, et cetera?

A: I would answer that question by saying the focus is on lower order transport methods, but we are looking for novel approaches that surround lower transport methods. I would think ideas or approaches using reduced order modeling would be considered applicable to this call. Keep in mind, there is kind of a time limitation on this response. If the scope doesn't change at all, you can take that as our answer on that specifically. I think it could apply, just make sure you're speaking to how it's a novel advancement and hopefully that's where this discussion of what we're really trying to achieve here is helpful on this call.

Q: NEAMS-1. Is the focus on developing a new code or is it more on working to improve an existing code?

A: I would say that the focus is really on developing novel methods that either are incorporated in one of our codes or could be. I really shy away from development of additional codes. That just kind of complicates the landscape. I understand if folks have a preferred code that they would like to develop and demonstrate the method…we're trying to be more open to those possibilities. Again, for it to be more beneficial to the NEAMS program and broader use, I would add at a minimum, ask that it's very clear how that new method that you've demonstrated somewhere else could be incorporated easily into one of our codes.

Q: NEAMS-2. Does the optimization have to be core level and will shape optimization of single fuel rod be considered?

A: I think the real desire is that the application is within the core. It could obviously be applied more broadly with different inputs besides temperatures and neutronics and what not. But the way the scope is currently written, that is the application that we're really looking for is within the core.

Q: For the automated optimization. Are there specific reactor types that you'd like to see them applied to?

A: No, we've, we've not specified that. We're really looking for something that could be used more broadly, it could be demonstrated on any problem that shows where the automated optimization is needed and makes a significant impact.

Q: There are already some low order transport solvers in NEAMS. Are you seeking some novel new methods or solvers, which will run faster with acceptable accuracy?

A: I think in a word, yes.

Q: NEAMS-2. Is the focus to develop optimization methods or to demonstrate existing methods?

A: No, it's much more to develop. Either to develop new methods or to apply methods that may exist in other areas. Whether it's aerospace or something else that have not been adequately or sufficiently

applied in the nuclear area. Again, I'd really like to see this be novel methods, as opposed to just applying methods that we all know are out there.

Q: It seems to me that economic analysis of the entire fuels cycle tools is missing and not embedded in the existing computational packages. I was wondering if you could comment on that.

A: I'm going to interpret that question having to do with broader fuel cycle analysis, and if I got that wrong, please go ahead and clarify. As far as the NEAMS program, we have really tried to narrow our operational space to multi-physics and multi-scale modeling and simulation. There is enormous opportunity and it's ever-growing for modeling and simulation more broadly. Whether from fuel cycle analysis, regulatory use, our integrated energy systems program does some of that stuff as well. There's AI and machine learning opportunities, but we've really tried to focus on the multi-scale, multi-physics problems of reactor system modeling. Just because there is so much to do in just that space alone, that could really benefit either the existing operating fleet or advanced reactor deployment. So, that as a program, that's why we have been somewhat limited to that space.

Q: For new transport methods, does the code have to be used? Does it have to use MOOSE as a framework for new transport methods?

A: I don't think we specify that in the scope. So, if we haven't specified that, then it doesn't. That is where there is a lot of opportunity, but there's also opportunity within the VERA suite of codes. If there's an improvement there that would be helpful as well, that's acceptable. It needs to be a significant advancement. The problem is really when you go to pin-by-pin modeling of a large system.

Q: I am trying to understand the requirement "low order transport methods to replicate Monte Carlo results". Which "results" is meant here?

A: The statement could have been worded better. We are looking for low order methods that approach Monte Carlo accuracy but with much less computational cost.

Q: Last year's call also mentioned Monte Carlo but also discussed transient analysis and depletion. Can you explain how the two calls are different or related?

A: The 2021 (last year's) scope was for development of Monte Carlo methods capable of transient analysis. The 2022 (this year's) scope is focused on low-order methods that can approach the accuracy of Monte Carlo. These are two completely different methods, and the scopes are/were aimed at addressing their respective drawbacks.

Q: Is it acceptable/relevant to put a proposal that had some element of incremental improvements/enhancements on current methodology rather than a wholesale new approach?

A: An incremental improvement would be relevant under this scope. The degree of improvement would obviously factor into its value.

Q: Are there specific reactor types that are or are not desired?

A: The call does not specify a reactor type; therefore none are out of scope, per se. However, the need for low-order methods only comes about as the reactor size gets larger and more computationally expensive methods become impractical. So the target application of any developed methods is clearly larger reactors.

Q: Will shape optimization fall into the scope? Will other optimization algorithms be considered as well?

A: Yes, shape optimization is in the scope. Initially, we mainly called for shape optimization algorithms, but we realized that other optimization algorithms are also essential for nuclear reactor core design. Therefore, all optimization algorithms for nuclear reactor core design are equally considered.

Q: Are any application problems particularly interesting for this call?

A: The call focuses on novel optimization methods that are applicable for nuclear reactor core design. We do not specify particular applications that the proposal should address as long as they are part of the nuclear reactor core design.

Q: When you mention shape optimization in the work scope, what do you exactly mean by that? Shape optimization can simply mean to optimize parameters such as radius of a fuel pin or height/radius of a fuel pin OR it can mean answering the question "what is the best shape for this particular purpose?" The latter question could e.g. be what shape is best for some flow feature in a channel to reduce drag or increase mixing. The implementation of the two approaches will be very different.

A: Yes, we mean the general case "what is the best shape for a particular purpose." Without physics, a simple example could be: "find a shape for a given volume such that the surface area is maximized." Optimize parameters could be a particular case of general shape optimization where geometry is parameterized. However, we broadened the scope to include other optimization algorithms/frameworks as long as they can be used for nuclear reactor core design and beyond.

Q: During the CINR presentation, it was pointed out that the focus of NEAMS-2 is on core-wide optimization. What does that mean? Optimizing the (a) shape of every pin in the core separately, (b) that the physics model need to be a core and not a fuel assembly, (c) you particular target something akin to core loading optimization as is done regularly for LWRs. Or maybe something completely different?

A: You could work on the reactor core as a whole, e.g., core configuration. You could also pick up particular components (such as coolant pipe shapes, control rods, fuel pins, etc.) you are interested in (while other components might be fixed or simplified). Generally speaking, problems related to the reactor core design would be in the scope. The whole reactor core design would be the most interesting, and it is also the most challenging. The most interesting optimization algorithms should be those that can address the design challenges from both the whole nuclear reactor and the individual components.

Q: Are the optimizations considering economic factors in the scope?

A: An optimization algorithm considering economic factors might be fine, but we do not expect comprehensive economic analyses in this call. The main focus of the call is on novel optimization methods/algorithms for nuclear reactor core design.

Q: Can we propose deep reinforcement learning as an optimization framework for this call?

A: Yes, it should be fine. But we are more interested in novel optimization algorithms in a traditional definition. The machine learning idea could be part of the optimization algorithm framework, but the

main development should focus on novel "traditional" optimization algorithms. A traditional optimization algorithm is one governed and driven by physics laws instead of data.

Q: Is evolutionary optimization strategy in the scope?

A: Applicants have the freedoms to propose any optimization strategy in which they are interested. We do not have a specific requirement for this.

Q: Do we have to use NEAMS tools?

A: You do not have to use NEAMS tools, but the existing NEAMS tools are preferred. We encourage users to use the NEAMS tools if these tools are helpful for their proposed approaches. We also suggest that the proposed work builds on existing capabilities within MOOSE.

Q: How "automated" do we mean?

A: We expect different components of optimization algorithms to be constructed automatically, and users' input is minimal. For example, a derivative of optimization objectives should be computed automatically if the derivative is required.

Q: How many awards for this call?

A: At this time, we plan to make at least one award, but that will depend on available funding.

Q: 15% Budget on a particular component of algorithms, such as AD, will be considered too thin?

A: We do not have a specific requirement for this particular call unless DOE specifies it somewhere else.

Q: Will experimental research be in the scope?

A: For this particular call, we focus on computational method development. Experimental effort can be part of the proposal, but novel computational optimization approaches should be the main focus.

Q: Would it be of any merit to demonstrate another platform that could better drive the optimization flow on top of MOOSE? Or would it be preferable to stay within the MOOSE framework in this call?

A: It is suggested that the proposed work builds on existing capabilities within MOOSE, such as automatic differentiation, displaced mesh, stochastic tools, and inverse solvers. The final goal of the study is to enable an automated optimization platform for MOOSE-based codes to better address nuclear energy design challenges.

NSUF Overview and NSUF-1 and NSUF-2

Q: Are there any fuels that are not of interest at the moment? For example, for structural materials, you call out specific materials that will not be considered. Can you comment of fuels please?

A: As far as I am aware, most fuel cycle fuels would be considered, though, in some cases, there is an obvious caveat. For instance, whilst NE is not currently interested in the thorium fuel cycle, comparison of, say, for instance, thorium-based fuels with uranium-based fuel cycle would be of interest. It all depends on the particular scenario. At the moment, the main focus of interest in terms of deployment in reactor is uranium-based fuel cycles. However, there are obviously niches where one might want to consider other appropriate fuel cycles.

Q: Does NSUF-1 support travel and salaries?

A: NSUF-1 will provide up to $800,000 of support for the university researcher. This money comes from the NSUF, and it would be used in the way that a typical university grant provided under the CINR operates. So, it would provide salaries for graduate students, faculty members, post docs, for travel and for all associated expenses, with regard to the particular projects. This money is distinct from the money that is provided for NSUF access to capabilities. In other words, the researcher, the PI, would receive a grant for the up to $800,000 award then they are awarded for time or utilization which would be. The appropriate cost that is necessary for the NSUF Access. When the project is awarded, it goes through a technical review. That means, the actual review looks at travel, salary, and everything in the project. So, yes. Travel is allowed, but it will be reviewed.

Q: Does the non-proprietary requirement apply to both NSUF-1 and NSUF-2?

A: Yes, as with all other CINR awards. In particular, that you would expect as an NSUF-1 to be non-proprietary because it's a university award and if you lack the metrics that many university professors are judged by when they come to promotion, etcetera, is publication. The reason that we highlight it for an NSUF-2 is that those are available to industry and sometimes there are commercial considerations. One would not expect to fund a piece of work that is commercially important or is required commercially and that the particular company is not prepared to make the results available to the general community.

Q: What are considered as radiation resistant materials?

A: I presume that the individual is talking about structural materials. Obviously, DOE is very interested in understanding the behavior and the performance of radiation resistant materials. We obviously don't want to bias a particular material or tell they have to work on a particular material. There have been a number of suggestions in the literature about materials to talk more radiation resistant than others, but as I say, you know, that's up to the applicant to define. If you like, the hypothesis is why those materials are radiation resistant.

Q: For NSUF 2.2, in high performance computing, is there an expected limit on the number of core GPU hours per year allowed and is there any limitation regarding the number of PIs?

A: As mentioned earlier, the proposals undergo review, and so, the concept or the idea there will be that the applicant would be expected to justify the amount of core hours that they are receiving and that it would be reviewed as whether it's appropriate or not. That is a part of the review criteria. However, the computational effort in those proposals or in those projects, can't be the majority of the work. At most it needs to be 50/50%. So, there has to be a very significant experimental part to those applications.

In terms of number of PIs, as far as I am aware, that's been in the past never had an explicit limit on the number of PIs. From my experience in writing proposals, the actual issue there is the herding of cats issue. How can you write and maintain a coherent project if you have too many individuals pulling in different directions? So, to the first question, the number of core hours are reviewed, and it needs to be justified in the proposal. To the second question, there is no explicit limit. However, organizationally, in terms of a management plan, that is always something that is difficult if you have too many. That's for the PI and the co-PIs to decide.

Q: Can national lab researchers participate as a collaborator for NSUF-1 when university PIs serve as the lead?

A: Yes, they can. However, there is a maximum of 20% of the money that can go to non-university partners. Total of 20% all together for this particular financial year's FOA. These rules were explicitly described in the general introduction earlier on and they will be explicitly stated within the FOA.

Q: Would modified 304 and 316 steels with purposely added additives be something that could be considered in these work scopes?

A: I think that the answer to that question is it will depend very much on the hypothesis. My feeling is that the only reason that we would want to consider those particular materials was if somebody was looking at the effects of the additives rather the performance of the material itself.

Q: The PI desires a particular researcher to perform work under an NSUF agreement. Should the NSUF facility researcher be included as a co-PI, collaborator, or under another title in the proposal?

A: According to the rules that are stated in this FOA, all NSUF technical leads and technical staff, that are known, should be included as a collaborator on the proposal. If somebody is included as a co-PI, the usual implication is that they will be receiving some of the R&D funding, as seen with NSUF-1. That may be a reason why somebody would be included as a collaborator rather than as a co-PI. But, yes, if somebody wants a specific person to be involved, they should certainly, as a technical lead or as a technical associate, be included as a co-PI on the proposal. NSUF will specify who we believe is the best technical lead.

Q: Is there any preference on the types of reactors or applications? For example, TRISO fuels and accident tolerant fuels as compared to more traditional fuel types like UO2 and metallic fuels?

A: We specifically state in the FOA that we're interested in both conventional and advanced reactor fuel types. One of the things Dr. Huff highlighted was the fact that we're not trying to be overly specific in what we actually request in this particular year's FOA. In principle, there should be no reasons why any particular fuel type could not be considered. It all comes down to any kind of research proposal. You have to be demonstrating that you're doing something novel, new and of value to DOE-NE's mission.

There is not much point repeating what has already been done and is available either in literature or in publicly available national laboratory reports.

Q: For NSUF 1.1, would you be interested in projects with modeling in conjunction with the experiments with NSUF facilities?

A: Not only would we be interested, we would be very encouraging about modeling and simulation with experimental projects with regard to the combination of experiments and theory and computation as being a positive. In terms of the performance of a project, it allows for both understanding at the same time as developing a new knowledge base, so it's highly encouraged.

Q: Could you please repeat the Letter of Intent and Pre-application deadlines?

A: These will be specified in the FOA and those will be the final dates. Currently, we are aiming for the Letter of Intent on September 2, 2021, Pre-application on September 22, 2021, NSUF preliminary status and scope of work on November 10, 2021, final SOW on January 20, 2022, and full applications on February 9, 2022. As I said, those are provisional dates, at the moment, and are subject to change until the final FOA is issued. They will be stated on the front page, the cover page, of the FOA when it is released. The letter of intent, with it being so soon, is hard to create a large IRP team. The intention of the letter of intent is to outline NSUF request not necessarily establish a team and have an entire research scope written in that timeframe.

Q: If we use NSUF to prepare samples and then build a separate facility to study the effect of irradiation on the material's other performance, would that be considered as an appropriate topic for NSUF-1?

A: The focus of the NSUF is on the performance of irradiated materials and nuclear fuels. Any NSUF project has to be based upon either the performance of a fuel type or the performance of an irradiated material. That is the primary criteria. It has to be an irradiated material for it to meet an NSUF scope.

Q: Do all U-based fuels need to be considered such as U-Zr, U-Mo, UN and UC?

A: We don't require people to consider all of those fuels. Now, in terms of the fuels that are usually of interest, U-Mo, of course is not part of DOE-NE's mission. That's a different part of DOE and would not normally be considered as a fuel we are interested in within in the CINR FOA. All of the other fuels, though, there is no reason why they could not be the subject of a proposal.

Q: Would you say industry PIs are encouraged for NSUF 1.1 applications?

A: Industry is not allowed to apply to NSUF 1.1. It is only available for university applicants. However, they are more than welcome and are encouraged to participate as a collaborator on applications. Up to a total 20% of funding can go to sources that are not universities. So if you have a national lab and an industry partner, they can receive up to, between them, 20% of the R&D funding. It cannot exceed the maximum of 20% of funding. Industry PIs are also encouraged to apply for NSUF 2 workscopes.

Q: On NSUF 1.1, can the project be led by modeling PIs?

A: We do not make a distinction between a modeling PI and an experimental PI. What we do require is the majority of the project be of experimental nature. So, if you'd like to you could have the majority of

the spend be of an experimental nature and so utilizing the NSUF access to show capabilities. The whole purpose of the R&D funding is to support the work being done at the NSUF capabilities.

Q: Can the cost of software licenses be included in the application for high performance computing time, or is a separate application required? One for funding and one for computing time?

A: We do not provide support for software in the HPC component of NSUF-2. What we do merely provide there is access to the computers. So, in other words, cycles and access to capabilities of software that is already available on the computer, subject to export control issues and the like. This is the point I made about software licenses. Know that an additional funding source is necessary for any software that is not currently exigent of the INL HPC capabilities.

Q: How about these materials made by other methods or dissimilar metal welds?

A: We are very interested in dissimilar material joining and, in that sense, those materials are appropriate. However, I'm not aware of another way of making bulk materials, other than additive manufacturing or conventional methods. So, yes, we are interested in joining of dissimilar materials and the performance of welds, etcetera in a radiation environment. No, we are not interested in those specific materials in bulk either produced conventionally or by additive manufacturing.

Q: For NSUF 1.1, will unique characterization capabilities complimentary to current NSUF capabilities from the University Lead be considered adding value to the proposed experiments to the review process?

A: We are interested in obtaining the most possible information from these research projects. Part of the proposal and the review process is to demonstrate that you have a holistic program of research that has got to develop, value, add impact as well as good science and engineering.

Q: What fraction of the award can go to experimental measurements, which are independent of the NSUF irradiations, such as TEM or SEM, etcetera?

A: How the money is allocated of the university partners is at the discretion of the PI. However, that has to be described in the full proposal and therefore, will be reviewed for scientific relevance and appropriateness. One would expect the vast majority of the NSUF $800,000 funds that is awarded to the PI will be spent supporting staff, students, etcetera at the university and access to university equipment for experimental purposes.

Q: You mentioned that NE is not interested in thorium fuel cycles? Are thorium related projects without a U/PU component specifically discouraged from applying per FOA instructions?

A: It does not specify that in the instructions. The thorium fuel cycle is not currently a major interest to DOE-NE. I believe that that is the case. One is interested in understanding the behavior of all the actinides, but, in particular, the focus at the moment given advanced reactors and conventional reactors is obviously on the Uranium fuel cycle and so any interest in the thorium fuel cycle would not be addressing the DOE-NE mission. Unless, it is somehow tied in, in terms of either developing knowledge, developing information, etcetera that is then applicable or providing understanding to fuel cycles that are currently of interest to DOE and its mission of supporting that of the conventional LWR leaked or developing and deploying a current advanced reactor that is being postulated or conceptualized by the industry.

Q: Would you consider uranium nitride fuels to be of high relevance to NSUF-1.1 studies?

A: Uranium nitride fuels are relevant to DOE-NE but I can't address the degree to which they are relevant. All NSUF projects can be checked out on our website (nsuf.inl.gov).

Q: Can one get access to AGR TRISO material through the program? If yes, would INL agree to lease the material – at no cost – to the project, or would that cost (access to AGR TRISO material) be included in an NSUF-2.1 NSUF request?

A: All material offered through the FOA are listed and described in the Nuclear Fuels and Materials Library (NFML) database found on our website at nsuf.inl.gov. AGR TRISO materials would have to be supplied by the NE research program, and access should be arranged by discussions with the program. A letter from the NTD stating that the material will be made available is required to meet the NSUF readiness requirement of the CINR FOA. All material in the NFML is and remains the property of DOE. Costs for the access to the materials should be included in the CINR FOA access request and are covered by NSUF.

Q: Does NSUF-1 include R&D funding for the PI and cover access to the facilities? Or does a PI still need to apply for an R&D topic for the R&D funding? Should a proposal be submitted as a single NSUF proposal that includes a request for R&D funds?

A: The $800,000 is referring to R&D funds only used in NSUF-1 areas to fund an R&D project along with NSUF access. The request in NSUF-1 should be for both the R&D and NSUF access. It is one proposal asking for both items. NSUF-1 is university lead only, so the submittal would need to be made by a university lead with a national lab collaborator.

Q: FOA mentions Program Concurrence Letter by DOE. Is this letter required when the Pre-application is submitted or later?

A: This letter is required at the full application stage.

Q: Are subcontractors defined as collaborators?

A. Yes, if they are involved in the project and will be participating in R&D activities associated with the R&D access they will likely have a conflict of interest. Please list them as collaborators.

Q: The FOA says "On industry led applications, the applicant's cost share requirement will be based on the total cost of the project (excluding NSUF access value). FFRDC costs are included as part of the government cost share." If R&D money is not being requested, is the cost share of the whole project a responsibility of the prime applicant?

A: Please refer to page 18 of the FOA. The last line states "Cost sharing requirements do not apply to the value of the NSUF access."

Q: We are requesting NSUF Access Only. So we are not supposed to request any R&D money under NSUF-2.1?

A: That is correct.

Q: I am not familiar with INL facilities. We plan to store the irradiated fuels in Materials Fuel Center (MFC). Should PIE be conducted in Hot Fuel Examination Facility (HFEF)?

A: You will be assigned a Technical Lead upon submission of an LOI with whom these decisions can be discussed.

Q: Do you think we can proceed to the Pre-application even though the irradiated materials are not ready as of today?

A: Until we see a full description of the state of readiness, we can't make a judgement so submitting an LOI is appropriate at this time.

RC-1.1

Q: How is this reactor concepts work scope related to nuclear engineering fields? It seems it's more related to civil and industrial engineering and social science types of studies.

A: The mission of NRIC is to enable reactor demonstrations that encompasses many different fields. For example, public perception like the environmental justice scope is something we need to take into consideration. It's a broad field that needs to be addressed. Part of the mission is to commercialize, and we need to bridge the gap between advanced reactors and commercial reactors. All issues need to be addressed, including siting, construction, and other impediments there are to commercializing a reactor with this broad scope.

RC-1.2: Environmental Justice and Equity Considerations in Siting Energy or Industrial Facilities to Inform Advanced Nuclear Energy Siting

Q: Would qualitatively studies on how to define justice and equity in the context of advanced reactor demonstration and siting also be of interest?

A: Yes, that would fall under RC-1.2.

RC-1.3: Implementation Considerations for Alternative Applications of Advanced Nuclear Reactors

Q: For RC-1.3: is analyzing effects of microreactor on electrical grid an interesting topic?

A: We are really interested in what potential niche markets that you can use microreactors and small advanced reactors in. There is a different work scope focused more on the microreactors that is focused on this question. We are looking more at applications that are not currently being pursued, and how we can use these technologies to support these specialized applications.

Q: Is there any interest in analysis of distributed electronic production systems as a compliment to irregular solar and wind power production?

A: Yes, there is some interest in that topic.

Q: Considering these broad scopes, can teams include researchers from non-NEUP universities?

A: Team members don't have to be on any certain list to be a partner on this application. There isn't such a thing as NEUP universities. There is only a list for the IUP Scholarship and Fellowship program where the university needs to be approved awards students through the competitive process.

RC-2

Q: Will the Instrumentation & Sensors development include consideration of proposals for I&C systems including innovative neutron sensor development for reactor power monitoring?

A: We would want to see the details in the proposal, though it sounds promising based on the question, though a strong case needs to be made for viability and improvement of microreactors philosophy; we suggest ties to utilization for autonomous control or health monitoring or something to that effect.

Q: **Is this part of the CINR FOA?**

A: Yes, it is listed in the FOA as funding for 3 years up to $800,000 for one project based on funding provided by Congress.

Q: Is modeling and simulation of interest? if so, what area and what computational tools are desired/needed?

A: Yes, they are of interest and program managers don't want to specify the tools for a proposal. However, we are always interested in the NEAMS tools, the MOOSE family, and again making sure we are doing something to improve the economic viability of microreactors.

Q: Is RC-2 for university lead or is Industry available to lead a project?

A: RC-2 is meant to be university led, but PIs can collaborate with industry.

Q: Would a new microreactor design fall in this workscope?

A: It could if described well in the proposal; however, with the funding available for a project limited at $800,00, could you design a new microreactor for that amount?

RC-3

Q: For RC-3.2, which coolant is the focused: sodium or lead? Also, which type of experiment is preferred between high resolution data using surrogate coolants or proto-typical conditions?

A: I think we're interested in both sodium and lead coolants. The need for fuel propagation damage, fuel failure, and damage assessment potential, is of interest for most SFR and LFR concepts. The second question; I think the preference would be proto-typical conditions; the fidelity of the data may not be of a major interest. If you can somehow characterize flow stagnation or flow reversal, and the effect of jet penetration in an assembly, we don't particularly need CFT quality measurements for that. We do however value the impact of fission gas jet impingement on neighboring fuel pin services. That's essentially the key factor in understanding the damage propagation potential. So, a detailed assessment of heat transfer degradation on the neighboring fuel pin surfaces would require some detailed measurements.

Q: Is there a type of sensors which are of interest in these calls?

A: It would be the sensors that would go into a typical LMR. So, it could be a flow sensor, it could be a sensor to measure elevation of the of the coolant. It is those types of sensors. So, if you look at what the instrumentation that you would normally put into an LMR type of plant, those are the sensors that would support industry, if you will, and the commercialization of the technology. Those are the ones that, that we would be interested in testing.

Q: As a follow up question on 3.2, can we use other liquid metals in a university laboratory since sodium and lead are challenging to handle in a lab? Would that be acceptable?

A: Yes, I think using other liquid metal coolants like gallium would probably be reputable for that purpose. Again, we would be interested in some scalability study to demonstrate that.

Q: Does development of advanced sensors for liquid metal environments include innovative neutron detectors?

A: I would say that it would. But, typically, those detectors don't necessarily see sodium. So, the focus of RC-3.1 is on alkali metal or liquid metal technologies, per se, that are actually immersed in the coolant itself. And the NIs are typically either ex-vessel or they're in a thimble inside the vessel.

Q: Which type of material should be considered in my proposal for the primary loop? 316H or a different material?

A: Historically, 300 series austenitic stainless steels are used for liquid metal reactors. For example, FFTF reactor vessel was 304 stainless steel, the hot leg piping was 316H and the cold leg piping was 304H. METL is made from 304 dual certified steel and 316/316L dual certified steel. The larger vessels are fabricated from 304H to allow them to go to 1200F. So, for temperatures 1000F and below, adopting 304 or 316SS is adequate. If temperatures are above 1000F, then utilizing high carbon SS such as 304H or 316H is the proper material.

Q: How to gain access to METL? Do I have to include METL facility folks as co-PI in my proposal?

A: You can reach out to any of the responsible engineers who are involved in METL, see https://www.anl.gov/nse/mechanisms-engineering-test-loop-facility. If you plan to perform testing in METL, it would be advisable to include a METL team member in your proposal.

Q: What is the neutron radiation flux or a range of radiation flux in the primary systems?

A: The neutron flux varies in the primary system and diminishes the further from the core. Grid plate structures, core barrels, and upper internal structures typically see about a few dpa during the life of the reactor. As an example, please see the radial total flux profile at core midplane at full power for FFTF, which can be accessed on page 51 of https://www.osti.gov/servlets/purl/6032523.

Q: I have been reviewing the new work scope descriptions for DOE-NEUP. The work scope of RC-3.1 in comparison to the last year is very similar, but with a few changes. What caught my attention is that the direct reference to the detection of impurities in the coolant (improvement of plugging meters or oxygen sensors) has been removed from the description. Any insight from you about the reasons for this change would be greatly appreciated.

A: In general, we thought that researchers were interpreting these examples as some special emphasis for RC-3.1 which these two examples of detecting impurities in coolant do not have a special emphasis. Impurity monitoring can be proposed under this RC-3.1 – however it should be a technology which provides a benefit and robustness to the overall liquid metal system over the current state of the art.

Q: With regards to NEUP work scope RC-3.1 on research related to testing of materials useful for nuclear reactors in METL facility, would oxygen sensor/meter development for monitoring oxygen impurity in liquid Na at METL be of interest for this work scope?

A: A proposal for oxygen sensors does fall under this RC-3.1.

Q: Will SCADA information access be possible in the realm of structural health monitoring of METL, that fits into the development of digital twin and AI control?

A: You should contact the METL facility manager.

Q: Would flow meters and corrosion monitoring fit within the realm of the RC-3.1 scope?

A: These are acceptable topics for RC-3.1.

RC-4

Q: Would NDE testing plans for pebbles be considered relevant to the RC-4 call?

A: Yes, it could be considered. They would like to understand the mechanical strength of the pebbles, especially if it was combined with mechanical testing to see the reduction in strength of the pebbles.

Q: For RC-4, is it focused more on the TRISO particle including layers of both graphite and SiC, or the graphite material?

A: It is focused more on the graphite structural material.

Q: Is experiment the must for RC-4?

A: It is not a must but could be a benefit to your proposal.

Q: Are there any guidance documents, such as a Waste Acceptance Criteria, for preparing spent TRISO fuel for disposal for RC-4?

A: Yes, it is believed so, however you will need to do some digging to find them. Right now, we are focused on structural graphite components for this IRP.

Q: Will RC-4 not cover the issue associated with large graphite quantities being unacceptable to a repository for spent nuclear fuel?

A: There is no regulatory rule that handles this new waste form; where are the gaps might be present and how should those gaps be addressed. Two historical sources of work were the 1990's work on graphite that was being decommissioned at that time. A fair number of reports came about addressing the issues that came out of work from Idaho and Oak Ridge, though the issues were not resolved. Also, a lot of work on this is being done in the UK and Europe in general, trying to reduce large graphite volume and process the waste. These are two good sources to review for a successful proposal.

Q: Considering these broad scopes, can teams include researchers from non-NEUP schools?

A: For NEUP Projects, there are no NEUP Universities or non-NEUP universities, so any US university can be on a team. Only the IUP Scholarship and Fellowship Program has specific IUP-approved universities.

Q: Is the research for fuel matrix material or graphite?

A: It is pretty clear within the call that we want real pebble material and that they are different from graphite. So I don't think this is something to report to the others

Q: Can graphite be used as a substitute for pebble material for initial tests, so long as real pebble material is used to verify the initial results?

A: While this is not specifically stated in call, this is a pretty standard scientific practice to begin testing as soon as possible when you don't actually have the material on hand (like many folks since pebbles haven't been made in 45 years). Again, I don't think this is something that needs to be reported to the others since it is relatively standard practice. But I will let you make the call.

Q: Can you list items that are NOT of interest for this call?

A: We don't want ab initio or MD modeling (Finite element of stress states is probably the most). We don't want a lot of microstructural characterization, specifically characterizing underlying degradation mechanisms and their minute influence on behavior. This is not as much a material science activity as it is an applied science or engineering activity.

RC-5

Q: Is it preferrable to have mostly computational research and if so, should it be led by a modeling PI?

A: We are looking for a combination of characterization and well as modeling, and we don't dictate the background of the PI on a project. A combination of both modeling and characterization should be included as they are both important. The data will come from the characterization that will be fed into the model.

Q: Are shielding materials to protect weldments and high heat effective zones against high neutron fast fluence of interest?

A: No, the focus is on the reactor pressure vessel steel.

Q: How can we access the ATR-2 RPV samples? Have they been put in the NSUF library yet?

A: We are in the process of putting them into the NSUF library and there is only a little more paperwork to be done. PIs can put them into their proposal.

Q: Considering that both model and experimental efforts have been funded in the past, are you seeking new models that are different than the ones that are already funded?

A: The goal is to take existing models and improve them. It's not that the models we have are not capable of predicting what's happening, it's that they are not predicting as well as we would like at the higher fluences and thermal conditions. We are looking for improvements.

Q: There are similarities between this topic and the RC-8 topic from last year, except for the addition of thermal aging. Does this mean we need to focus on thermal aging this year?

A: It needs to be a combined effect this year. Yes, they are similar but additional information is needed because of currently evolving concepts.

Q: If a PI wants to access the samples, how would they identify them in the proposal?

A: There is a database that will be available for them to examine and make their selections. It is not there now, on the NSUF webpage, but it will be available.

Q: Are we trying to understand potential thermal aging induced degradation at the reactor operation temperature, or is it something else in this scope?

A: Yes, under the operating conditions at the reactor pressure vessel, not the internal temperature.

Q: Are studies focusing on the evolution of dislocation loops of RPV steels of interest in this call.

A: Yes.

Q: What is the requirement on the final delivered predictive model? Are we looking for an engineering model with similar functions of ASTM E900 or physics-based model predicting the key embrittlement mechanism such as late phase formation?

A: It's going to be focused on an extension of E900, instead of E900. There is an existing reduced-order model that was developed by Odette and Morgan that is a referenced in the workscope.

Q: For thermal aging, since the US does not have the thermal aging samples, can you advise on where to receive such samples?

A. Since we were unable to obtain the Palisades NGS thermal surveillance capsule as anticipated due to Entergy's changing decommissioning plans, we are only aware of two other sources. The first is from q thermal capsule that Westinghouse tested years ago. The second is material that may be obtained by EPRI and the PWROG from the decommissioned Indian Point pressurizer. However, neither of these materials are currently under DOE control.

Although, there are no readily available thermally aged RPV samples in the US, the following information and references may be of help.

<u>Thermal Aging of RPV Surveillance Materials Research (Russia and France) and Code development:</u>
According to the French code, to account for the long-term thermal ageing embrittlement of the low alloy Mn-Ni-Mo steel base metal, weld metal and HAZ, paragraph Z G 6133 of the French RCC-M Code generally considers an upward shift of the initial (or beginning of life) value of RTNDT in order to estimate the value of RTNDT of the material at the end of life. The rules, applicable to 16MND5/SA-508 Class 3 type of steels, can be found in the 2020 edition of the RCC-M, in which some values were corrected in Table Z G 6123 compared to the 2007 edition + 2008 and 2009 addenda. The values of ΔRTNDT given in Table Z G 6123 of the RCC-M Code are given in an analytical form in the RSE-M Code, Appendix 5.6, §IV.1.1.1.2.

<u>Partial list of Thermal Aging of RPV Surveillance Materials References:</u>
A.A. Chernobaeva, E.A. Kuleshova, M.A. Skundin, D.A. Malsev, L.I. Chyrko, V.N. Revka, REVISION OF DATA BASE OF VVER-1000 THERMAL AGING SURVIELANCE SPECIMENS, Transactions, SMiRT-22, San Francisco, California, USA - August 18-23, 2013

B.Z. Margolin, E.V. Yurchenko, A.M. Morozov, D.A. Chistyakov, "Prediction of the effects of thermal ageing on the embrittlement of reactor pressure vessel steels", Journal of Nuclear Materials, vol. 447, pp. 107-114, 2014

Y.I. Shtrombakh, B.A. Gurovich, E. A. Kuleshova, D. A. Maltsev, S. V. Fedotova, A.A. Chernobaeva, Thermal ageing mechanisms of VVER-1000 reactor pressure vessel steels, Journal of Nuclear Materials, vol. 452, pp. 348-358, 2014

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L. Sun, P. Joly, P. Efsing, J.P. Massoud, F. Somville, R. Gerard, Y.H. An, J. Bailey, Mechanical properties and microstructural investigations conducted on base metals and welds of the pressure vessel of a decommissioned PWR Pressurizer, after 27 years of production, Fontevraud 9, Contribution of Materials Investigations and Operating Experience to Light Water NPPs' Safety, Performance and Reliability, 2018.

RC-6

Q: Advanced heat exchanger technology that provides higher performance and compact size for multiple SMR concepts, is this topic still in the scope of the call this year?

A: Everything relevant to SMRs is in the scope of the call this year. Make sure any application describes the current state of the art and what your new idea would add to the state of the art.

Q: Would a new reflector for the SMR be of interest in this call?

A: That would depend on something in the application demonstrating the types of reactors it's beneficial for and how it's beneficial. It's not about the specific type of technology, it's about showing there's a gap in technology and how this new idea will fill the gap.

Q: What kinds of online sensors would be of interest in RC-6?

A: We have not narrowed the scope to that much to describe the type of sensors, so it's up to the applicant to propose a new type of sensor.

Q: Does the total budget limit include what will be given to the US and international team or does the limit only apply to the US team because the UK team will get their funding individually? I just want to be sure I understand what documentation is needed and the budget limitation.

A: The budget limitation refers to the US request. The UK will respond to its own funding opportunity. Please do include the UK contribution in the project narrative, along with the overall US budget request so we can understand how the two requests will be coordinated.