

FY 2020 CINR FOA Workscope Specific Q&A

FOA Overview Session

Q: Normally how many PIs are on a team?

A: That's completely up to the applicant's institution. We don't have a maximum number or a minimum number. We have seen single applicants and we've seen many applicants. Typically the prime awardee has a single PI but there can be there can be multiple Co-PIs named but the main interaction once the award is in place would be with a single PI i at the University or other entity that would receive the award.

Q: We were told the that the impact of reviewing the semi-blind process would be analyzed by DOE-NE, i.e. the diversity of Pi is receiving funding. I would like to know the results of this analysis.

A: We presented that at the NEDHO meeting in well, I guess we didn't announcements were made after that. But actually the number the percentage of Jr. PIs, is that is assistant and associate professors that received Awards actually went up. It's up to 59% Junior faculty now as a result of changes in the semi-blind process, and we also had 18 percent of the awards went to female faculty, which is up slightly. 77% of the awards had collaborators at national labs, which also went up. 41% of the awards went to projects that had collaborators with industry which also increased. Also 19 first time University PIs were awarded out of the 39 that we've awarded so far, and 61% went to nuclear engineering departments. It's not required that you be in a nuclear engineering department to be a PI and that number has fluctuated over the years to a little less than 50% but it's back up to 61 percent now. Those are that's the analysis of the current statistics. At the NEDHO meeting coming up at the American nuclear Society, these numbers will be provided with the retrospective look with what has happened in the past. The number of awards going to junior faculty went up and the number of wards going to female faculty went up. The number of awards going to Industry collaborators went up as well as the number of national lab collaborators. We believe this is a very positive thing. Thank you for the question.

Q: Do you have any recommendations for new Junior faculty?

A: Well in terms of make sure you read the FOA, make sure you're addressing all of the points brought up in the work scopes. This is a mission-oriented kind of approach to doing research, so make sure you're addressing the needs in the work scope in the FOA. It's good to have collaborators, though it is possible to win an award as a single PI though that's somewhat unusual. So I think because of the nature of the kind of projects we have, they are interdisciplinary and it's very unusual if you had all the expertise yourself so seek out good collaborators. They don't have to be at other universities. They could be at your own universities, but perhaps other departments and but certainly they have to be the best to address the problems in that particular work scope. Another suggestion that I would have as opposed to just reading the FOA, take a look at the Q&As that are posted at NEUP.gov website. They can be a huge help to you in clarifying a variety of a of information that's in the FOA. All prior work done by the department through this program is fully listed in the available on the NEUP website under the

roll down for the appropriate program area. If you hover over R&D the roll down menu will give you a list of full abstracts and final reports are available so you can see all the work that has happened in the past. Also, it was also suggested that you talked to the technical points of contact before the pre applications are due to discuss what you have in mind in terms of the project. I think that's always a good way of doing business and to have them help you in the long run. However, if the technical points of contact are not responsive, let us know and we will try to make that happen.

Q: For an NEUP R&D proposal, can I budget small equipment?

A: Yes, you can budget small equipment. There is no maximum or minimum allowed in your application, but it must be justified for the purchase.

Q: Many times the reviewers may misunderstand the proposal during the review phase. Are questions of clarification encouraged in the review process? Has the CINR considered a rebuttal or response phase?

A: We do not have a rebuttal or response phase for CINR though you do have opportunity to address any comments from your pre-application by writing your full application appropriately. Please understand that we're working with current year fiscal dollars in the year they are spent and we have to account for a full application and review process as well as the full contract negotiation phase. We have what seems like ample time that really gets whittled away. Currently in the FOA. There is a section when looking at IRP panels, we may have an opportunity there to ask questions of the finalists for the IRP awards, which are larger awards. We're trying to work that into our Merit Review Criteria and our ability to ask questions at that time. It would be a very limited kind of scope in terms of asking questions and trying to get things clarified from PIs at that point, and only for IRPs.

Q: Could you repeat the minimum scores for The Uninvited proposals to be only technical peer-reviewed?

A: For your relevance to score you have to have at least high relevance. That's an average score between your two reviewers and for program priority, it has to be at least a moderate program priority score. The difference between those two things is that for relevancy it could be seen as highly relevant but perhaps it department already has made an inordinate investment in the area and is waiting for research results come back before they want to move on. While something maybe of an high priority, it may be very high relevance, but it may be very low priority. Those are two separate issues.

Q: Can the current PI of an ongoing and NEUP project be on an NEUP pre-proposal this year as a Co-PI?

A: Yes.

Q: What is the policy of non-funded industrial collaborations?

A: I don't know that there's a policy that exists for non-funded collaborations. However, those institutions if they are a National Laboratory, even if they are non-funded must have a letter of authorization, so do be cognizant of that. If they are making a contribution it should be fully captured and the benefit of collaboration document and they must be listed as a collaborator. This is the same for industry. If you have a zero-dollar collaborator, we still want to know about them and to understand the nature of the collaboration listed.

Q: During the pre-proposal stage. Can you submit both a research proposal and an IRP proposal, for which you are the lead PI on for both?

A: You may choose to campaign a pre-application and then not campaign a full application. You may not be awarded a full application and an IRP application at the same time, but you could have a pre-application you campaign along with an IRP application then you'd make a decision on whether to submit the full application or not.

Q: Can other government entities collaborate i.e. US NRC or others?

A: We have seen collaborations with other government entities. Sometimes funding between those agencies is not allowed because it's not a double-dip situation. So I'll turn to Joanne for any additional guidance on that. No, no double dipping. This information will be very clearly spelled out on the FOA on who can collaborate

Q: A Follow up on the small equipment budget question. How much of the budget is allowed for small equipment?

A: There's no limit right now. But if it was only an equipment proposal it's unlikely to be funded because there's no work actually being done. So, of course, there's an Infrastructure FOA that you can ask for equipment up to three, four, and five-hundred-thousand dollar range with some cost sharing requirements. Equipment can be purchased though the R&D call that is not a problem, but it is relative to the size of the award. We've seen some equipment on the order of a couple hundred thousand being used in a standard R&D project, which are \$800k. I think the question was also regarding a letter of intent in particular right the same thing. The same answer applies for the Letter of Intent (LOI)

Q: Can a person be Co-PI on two applications?

A: Yes. If you're in the university community, you can be on up to six applications three as a principal investigator and three as a Co-PI. If you are not a principal investigator on any of those applications, you could be a Co-PI on six applications and then the numbers just vary between those boundaries.

Q: Are there any special cases where pre-award spending can be activated Beyond 90 days prior?

A: An example would be if their International vendors involved for example. Yes, it can be extended but you must have Contracting Officer (CO) authorization prior to the going over the

90 days. You also have to have approval of your own university of course because they will have to pick up the tab if something goes wrong.

Q: Are pre-applications not required for any R&D proposals as was done in FY 2019.

A: No pre-applications are absolutely required this year that was unique set of circumstances that happened in 2018. Last year we had pre-applications and I think everyone was pleased with the institution of pre-applications. Just to follow up pre-applications are not required for an IRP.

Q: Can a foreign collaborator receive funding if the foreign institution matches funding?

A: No.

Q: Is there a maximum number of active projects than industry organization can be on or collaborate on at any given time?

A: No. One clarification here on the NEET work scopes; as you can only submit three applications per work scope per institution as lead.

Q: What is the difference between an LOI and a pre-application? so a letter of intent that notifies the NSUF office that you are going to submit an application to their shop. What they need to do is find the appropriate technical representation from the complex to work with you on a statement of work. A pre-application is a three-page document that is fully reviewed for relevancy and that attracts a single technical review that should describe and discuss your project to the extent that a decision could be made on an invitation. So that's the difference between an LOI and a pre-application. LOIs are only for NSUF.

RC 7-8-9 Light Water Reactor Sustainability Workscopes

Q: What is the meaning of pristine is there a specific steel alloy on mind and Does it include nickel-based alloys?

A: Pristine here means non-irradiated materials. I think we are looking for particular stainless steel used in the structure and internal parts of PWRs. Nickel-based alloys are also under consideration.

Q: Allison is cybersecurity a consideration for the plant modernization R&D pathway topic.

A: Cybersecurity is within plant modernization, but we don't specifically have a work scope calls that out this year. There is another cybersecurity area in the NEET (nuclear energy enabling Technologies) category, that's more general.

Q: Is the corrosion propagation rate included?

A: I wouldn't exclude the crouching at the proper crack propagation for the for the type of study. But I think in that the pristine stainless steel the crack initiation would be more of technique focus on relevance.

Q: Are radiation effects under consideration?

A: Yes.

Q: Does RC-9 include corrosion mitigation strategies as well?

A: The FOA is focusing more on understanding the corrosion process damage mechanism and the how the different chemistries and alloy microstructures would affect it. From there the optimum outcome would be to figure out a technique to mitigate the corrosion damage effects that would be ideal. Corrosion mitigation strategies are not the first step, but instead possible future work in this area.

Q: What type of results are expected from ICME modeling?

A: If we can figure out certain effects of material microstructure surface condition the page level of potassium, on the corrosion rate, the crack initiation rate, etc., those are the results we would like to see.

Q: Is pitting initiation part of the study?

A: No.

Q: Why KOH not NaOH? Is NaOH also of interest?

A: Not in this FOA.

Q: Is swelling of interest in RC-9?

A: No.

Q: Are material specifications for advanced manufacturing of Interest?

A: Not in these work scopes. We do have an advancement manufacturing program within office of nuclear energy that may address your questions.

Q: On RC-7 is an online decision-making tool expected as a potential deliverable?

A: It would be part of that effort. So it would show that application and what type of tool would be used to automate that process.

Q: RC-9 is this PWR specific; will be BWR conditions also be considered?

A: This is more PWS specific.

RC-3: Liquid Metal-Cooled Fast Reactor Technology Development and Demonstration to Support Deployment

Q: Is funding only supported experiments in metal?

A: Yes, experiments within the metal facility or that have a direct application to enhancing the metal facilities capabilities.

Q: Are industrial Partners encouraged?

A: Yes it would be good to have an industrial partner that would give them a better idea of the needs of the current technology developers for testing requirements. That would be recommended

Q: Can we build a metal loop or do we have to use the existing facilities?

A: The purpose of this scope is to utilize existing facilities. But with that being said there are capabilities utilizing a metal facility to make your own experimental infrastructure that may include small loops or applications like that, utilizing the facilities and the vessels within metal.

Q: What testing advanced heat exchangers or steam generators be of interest? on this is a very young broad application.

A: This is a very broad application and if the applicant can link that with a direct on industry or on research needed for near term deployment fast reactors, then that is within this scope.

Q: Would the scope be supportive of passive reactivity device designs?

A: I believe one of the areas that was shown in an example includes on novel and Innovative shut down techniques on that particular area. Once again with the same caveat if there can be a direct linkage to industry need and a priority, yeses that can be explored within this facility as well.

RC-2: Micro Reactor Deployment Markets

Q: RC-2.2: Are you interested in swelling data to validate NEAMS tools for micro reactors?

A: Data that addresses validation gaps for modeling and simulation of microreactor structural materials is of interest for the call. The proposal should describe the gap in data that is

addressed, how it is relevant to microreactor designs and applications, and how it will be used for validation of NEAMS tools.

Q: Can you please clarify the meaning of micro reactor dimension MEWs, etc., regarding the economic comparison with cellular wind energy diesel and gas turbines?

A: I don't think there is a set definition on what in micro reactor megawatt electric output would be and a lot of that is dependent on current markets that are being analyzed. For purposes of discussion, some being looked at range 1 to 5 megawatts electric and I believe there are ones looking at ranges all the way up to approximately 50 megawatts electric. I'll be on highly dependent on the applicant to ensure that they show the market need and the MW output. Generally micro reactors are defined by their transportability, unique features, and easy deployment pathways and smaller footprints. It will be on the applicant to show how these reactors will meet the energy needs of particular markets mentioned in this proposal.

Q: Do you expect RC-2.2 projects to focus on experimental work?

A: RC- 2.2 is focused on validation. Two pathways being explored are on either application of previous experimental work to validate these tool sets or developing new experiments that will generate data to validate these tool sets that falls within that realm.

Q: RC-2.2 Will the heat transfer research area include validation of MARMOT thermal conductivity models for fuel and cladding materials?

A: We will consult with our TPOC to provide an answer to this question.

Q: RC-2.2 Are you interested in swelling data to validate NEAMS tools for micro reactors?

A: We will consult with our TPOC to provide an answer to this question.

Q: RC-2.3 Are human factors issues of interest to this scope?

A: Yes, I believe we do have a broad enough category for some of the enhancements within the RC 2.3 scope. It's really broad and showing ways to reduce operational needs and staffing in ways to better overall operate the reactor, and human factors may fall into that area. It would be on the PI to show on a direct need to the micro reactor community and what benefits that would employ to this community.

Q: RC-2.2 What about new small experiments to close modeling and validation gaps?

A: Absolutely new experiments that can fill that validation requirement are more than welcome and the RC 2.2 area.

Q: Regarding the economics comparison, what are we supposed to compare it to; wind energy, diesel, gas turbines, other energy sources?

A: Once again, this is more of an exploration of potential markets and depending on the market that you're looking at. It would have to be incumbent on the applicant to see what the leading energy markets are in that particular area, what are the different resources, and even if micro reactors have an applicability in that particular area. Generally, it should be more focused on areas where it seems as we've defined a market for micro reactor deployment applications. It may not be competitive in terms of a base electricity production. But there may be other applications for process heat disaster relief energy resilience remote applications as well. So it would be incumbent on the applicant depending on what area they're looking to compare to those particular areas, if they feel that's necessary for their assessment and their case for a micro reactor to be deployed.

Q: RC-2.2 What could be the conceptual designs for gas cooled or heat pipe cooled micro reactors?

A: Once again I can for that on the to email and just provide some generally open available data from leading developers with those particular concepts. There are leading developers looking at both of those particular concepts both on the gas cooled and heat pipe cooled designs and we can help them with overall engagement with the national laboratory experts that would benefit this particular area as well to have a better understanding of the state of the art and the leading designs that are being explored and common cross-cutting issues they are experiencing.

Q: What about developing new computational models?

A: That is not within the scope of this particular area. As stated, we are not looking for the development of new models, we're looking for the validation of current sets with experimental data.

Q: RC 2.3. Any new idea is within the scope? With the caveat that the idea needs to show a clear need by the micro reactor community and also must have a detailed deployment plan and budgeting strategy and also an exploration of the technical readiness of the item. We are looking for a relatively near-term deployment of micro reactors and we are looking for items that can enhance the current state of the art or if it isn't an innovative item, what would be the pathway to bring it to a high technical readiness and it's applicability to commercial sector.

IRP-RC-1: Infrastructure to Support Molten Salt Reactor Components

Q: The RC-1 calls for new alloys especially having high temperature strength up to 950 Celsius. This means the current Ni-based alloys (Hastelloy N, Inconel) and stainless steels (314, 316) don't meet this high temperature requirement, because their mechanical strength drastically decreases when the temperature is above 750 Celsius. What other alloys would qualify?

A: We are interested in any advanced alloys that can satisfy the requirements that we stated in the scope of RC-1 of the CINR FOA

Q: What is the RC-1 program really looking for, high entropy alloys?

A: We are interested in structural alloys that can satisfy the performance characteristics that we outlined in the CINR FOA for molten chloride salt fast reactor applications.

Q: Should component design be submitted to this workscope?

A: You asked if a component design proposal should be submitted to the IRP-RC-1: Infrastructure to Support MSR Research and Development. The work scope states that advanced heat exchangers are an important area of research for MSRs. However, work scope further states the following: "However, the emphasis on proposed efforts should include the establishment of new or enhanced research infrastructure at universities to broaden the base capability, to provide high-quality data for model validation or material property performance and prepare students to enter the emerging advanced reactor technical field."

So, assuming that you are proposing to build infrastructure to test the component then IRP-RC-1 is the correct work scope. If you are only proposing to build a component then I would say that is outside the intent of the work scope.

Q: How many Cooperative Agreements are expected under this work scope?

A: I anticipate making one award for this.

Q: Are multifaceted SETs desired?

A: Yes, that's exactly what we're looking for. I would ask that when you do submit that type of work and do something multi-facet. You need to describe it in great detail, so we can understand the interaction the compliments and how they interface.

Q: How is this different from an infrastructure proposal?

A: It's not just an infrastructure so proposal. If you're doing something that's going to be new, it can be concentrated on infrastructure, but if you're doing something on enhancing capabilities, for instance go back to what I was talking about earlier heat exchanger, you can be saying our infrastructure wants the support the development of a new molten salt heat exchanger and that heat exchanger takes these design efforts and that design efforts has to have this infrastructure. So it's much more wide and its scope than just an infrastructure IRP.

Q: Are collaborations with international partners encouraged?

A: We have looked at putting international partners in here. Unfortunately, we do have some issues that are arising now and we've taken that out. We'll look through the proposal but it will be a case-by-case basis depending on who those partners are.

Q: Are there mechanisms to connect groups with a relatively small scope to a larger working group on a collaborative of proposal?

A: There are mechanisms to do that. This IRP is not one of them. Those mechanisms really need to be generated from either industry or the university to create those those opportunities. There may be some additional information that you could get from our services through GAIN or sort of concierge service or bringing people together. That may be something we could explore, but that is not something that we offer as part of the FOA.

Q: Can you identify specific radiation damage requirements?

A: Yes, we probably can do that. That's probably much more of a technical question than can be answered in the webinar. Please email us and we can address those questions then.

Q: Is there a desired makeup of the advisory team?

A: There's not a desired makeup. I do I support a much broader breadth of university and collaborations with industry. We have seen proposals in the past that don't have multiple universities on them. They don't have a broad breadth of experience and they don't have the technical background and awareness of what industry is wanting. I would support proposals with a much broader depth.

Q: Are the enhanced University capabilities described in the call allowed to be developed at an industry partners facility?

A: That is totally under the discretion of the university and their partners. We will not control that we would just be reviewing their proposal for its process.

Q: Is Improvement of nuclear data part of the scope?

A: Yes, it could be part of the scope. I think it would be very good to be able to address specific questions about cross section information for molten salt reactors; driving down uncertainty analysis by specifically looking within a certain spectrum, in certain salts and isotopes and structures.

Q: Is the intention that the capability is developed here become part of the NSUF and NSUF User Facility Community?

A: It's not our intention that certainly is an opportunity that if somebody wanted to take this infrastructure and continue to build on it for a larger system that could support NSU F that is that would be fine, but it is not our intention to have that being driven in that direction

Reminder: IRPs do have special requirements. Please do refer to the FOA, when it's released, to understand those requirements. They do not include a pre-application, but there are specific requirements about teaming including a requirement to have multiple universities. So anybody who is planning on applying here, please read through those special requirements.

RC 5: Experimental Validation of High Temperature Gas Reactor (HTGR) Simulations and RC-6: Fluoride Salt-Cooled High Temperature Reactor (FHR)

Q: RC-6 Is there a desire for a pump manufacturer to be involved?

A: If the applicant can show a correlation to available technologies to fulfill the needs of the workscope, then this would be beneficial. Similar to the other categories where engagement with industry and their capabilities are needed to address these issues, then that would be encouraged.

Q: RC-6.2 Do we need to introduce or develop new materials or are we doing tests on existing materials?

A: It's certainly a preference to be able to use available structural materials for the external boundary of the salts. As far as internal materials, we're open to any application with any new material and coating applications that would help with bearings and seals. They're going to be it's just expected. It's going to be a specialized material. It's certainly okay to explore that campaign doing some work in this area looking at things like galling tests and some tribology testing, but at this point that data isn't ready to inform design.

NEET-2, NSUF 1.1: Advanced Sensor and Instrumentation

Q: NEET-2.3 Would remote sensing technologies qualify as radiation hardened systems if they can do the job of in core or near vessel sensors?

A: Yes.

Q: NEET- 2.2 What is the expected time frame for demonstration and deployment of the newly developed technology in the fleet?

A: It depends on the application and what technology are they going to propose. They need to come up with a time line themselves as PIs.

Q: NEET- 2 Are the potential applications for current nuclear power plants or advanced reactors?

A: For this FOA, we would like applications for advanced reactors. There are FOA worksopes for LWRS work that they may have some related topics. Since we're cross-cutting if you're proposing something that applies to advanced reactors, sometimes they will benefit the existing fleet as well.

Q: NEET – 2 Are international collaborations encouraged under the NSUF program?

A: We will follow up with an email response.

Q: NEET-2: What do you expect in terms of demo of the new sensor and instrumentation? Is there a particular component of NPP of Interest?

A: No, I think you should propose your component how you're going to solve it. You can go on our website and see what our advanced reactors or the fuel cycle

NE-1 Cybersecurity Research

No Questions.

Infrastructure FOA Overview

Q: Would there be interest in proposal with new NSUF facilities proposed?

A: Specifically ones that are not involving irradiation such as mechanical testing or thermohydraulics? Yes, we would definitely be interested in seeing those.

Q: What is the solicitation number?

A: DE-FOA-0002129.

Q: For GSI applications are vendor quotes for equipment necessary in the proposal?

A: Yes, they are for equipment above \$5,000 they are required to have a vendor quote.

Q: Can you please clarify the cost share for General infrastructure?

A: It initially said 1 to 1, but the example showed 7 to 1; \$350k to \$50k. Yes, so it's required for anything requesting above \$250,000, we require a 1 to 1 cost share. If you were to have the total cost of the proposal to be \$300,000 (which is \$50,000 above \$250K) half of that \$50,000 would be required by the university and the other half (\$25,000) would be covered by DOE. We would therefore put in 275,000, but the university would be required to put up \$25,000.

Q: Are there specific areas of interest for this FOA in the general scientific infrastructure area?

A: Not really but we do look towards establishing or improving capabilities for handling radioactive material and nuclear fuel and material examinations or characterization.

NSUF Overview

Q: Since HPC does not include direct funding does it count against individual pre-proposal count for University PIs?

A: No ,NSUF-2 applications don't count against your university PI proposal count. The reasoning for that is the PI is not going to be doing work, instead, they're going to be getting the results of some type of NSUF project. So we will move on Dan.

Q: What is the difference between NSUF-2 and a rapid turnaround a proposal?

A: A rapid turnaround experiment is an entirely different solicitation process. They are similar in this sense that in both the rapid turnaround experiment and an NSUF-2 Work scope are operating in a user facility mode where R&D funds are not provided. The big difference, of course being that a rapid turnaround experiment is pretty small might involve two to three weeks of facility access and has to be done in nine months and has a target of about 50 k. The NSUF-2 work scopes can go clear up to \$4M, they are much larger projects and can take up to seven years. So rapid turnaround experiments are small quick projects and NSUF-2 are larger more extensive projects.

Q: Where would a proposal related to nuclear data measurement fit?

A: We have entertained some a nuclear data projects on NSUF in the past; so it's possible. We probably would entertain that in NSUF-2.2 and there are separate nuclear data work scopes related to nuclear data in the NEAMS category and there's one dedicated scope called MS-NE-2. Both areas are University lead applicants. So there's three possible opportunities

Q: My R&D project expires next summer. Can I still apply for an NSUF this year?

A: NSUF-2 does not count against any type of limit. You can look at the eligibility restrictions in the FOA for a university PI, which I assume is the case here. You can submit six pre-applications with no more than three as a lead PI and you can only submit enough projects that you're eligible to win.

Q: Would investigations or applications of computational fluid dynamics be appropriate for this year's HPC work scope?

A: Yes and We would evaluate that against the pool that we receive.

Q: Can one PI proposed in NSUF-1.2 and NSUF-1.3 at the same time?

A: Yes, you can you can submit up to your limit of applications as long as they are different applications. Meaning you would not submit the same application to NSUF-1.2 and in NSUF-1.3 or any other work scope for that matter. Individual different applications can be submitted to different work scopes.

Q: Readiness apply to the LOI or just the pre-application?

A: The Readiness information we're looking for is only in the summary in the pre-application and a detailed description in the full application. There's no need to try and address that in the letter of intent. The purpose of the letter of intent is to start a conversation with our technical leads and facility folks so that the applicant develops a pre-application that's actually something that can be achieved.

FC-1.1, FC-1.2, MS-FC-1, MS-FC-2: Materials Recovery

Q: What salt chemistries are of interest now?

A: Chloride salt for the program support. For the mission supporting, for fluoride and chloride salts are included.

Q: For MS-FC-1 and MS-FC-2, are the salts aimed at pyroprocessing or the molten salt reactor, or both?

A: Both, we see molten salt that can use in the pyroprocessing as electrolyte. But when the molten salt is applied to a reactor it can be a coolant not the solvent. So the fundamental knowledge of molten salt chemistry will help. So we encourage you to be generic this case.

Q: Do you need corrosion-resistant ceramic materials to contain the molten salt?

A: That's not under this scope.

Q: In FC1.1, is the target separation a liquid-liquid separation or are other systems such as liquid-solid of a interest?

A: Both. This is a new topic. We encourage you to submit innovative ideas. I'm I forgot to mention one things. You don't necessarily need to use actinides, you can use lanthanides to study the process.

Q: Is the continuum level of modeling and simulation of interest too or only atomistic level?

A: If you can develop some innovative modeling ideas we welcome that. I'm not saying which one we encourage which one we don't encourage.

Q: Is there any interest in solid electrolytes for these applications?

A: Solid electrolytes is not under the scope for this to this call.

NEET-1, NSUF-1.2, NSUF-1.3: Advanced Methods for Manufacturing and Materials Discovery and Qualification Initiative

Q: For NSUF-1.2, is solid state diffusion bonding covered in the call?

A: If it is related to irradiation of the material, definitely.

Q: In NSUF-1.3, is there research funding associated with that call?

A: Yes, and it's up to \$500K over a period of three years.

Q: For the surface modification, are you mainly interested in corrosion protection?

A: It's part of it. There are resistant applications for components, anything applicable we will accept it.

Q: I noticed concrete was mentioned in your presentation. What other materials are of interest?

A: Well, that's the only one I can think of right now, but if you can come up with anything else, please do so that's certainly the interest

Q: For NSUF-1.3, what TRL level for technique development is expected?

A: All TRL levels.

Q: For NSUF-1.3, does the material have to be produced through high-throughput fabrication methods?

A: No, not necessarily. It'll all depend on a case-by-case basis when we review but the principle is to again is to accelerate the fabrication characterization, ultimately, the qualification of the material. So as a strict answer, no, it doesn't have to be.

Q: For NSUF-1.3, does it require the utilization of user facilities?

A: No, it does not. For the R&D dollars, you can spend them wherever you would care to spend them but NSUF facilities are available for the proposer.

Q: So to be clear, you are looking for an NSUF user facility component in NSUF-1.3, correct?

A: Yes.

Q: For NSUF-1.3, must proposals include fabrication characterization modeling and analytics or is a focus of just one or two of these areas of interest?

A: Focus on one or two of these areas. That's fine.

Q: Does NSUF-1.3 allow high throughput calculations followed by machine learning and verification by experiments within the scope?

A: Yes.

Q: On NSUF-1.3, do we understand this correctly? This does not require use of an NSUF facility and is the funding for this also \$1 million for three years?

A: No. It's \$500K for three years for the R&D dollars. And yes, we would we have to have yes, we want to have you use NSUF capabilities for this.

So, yes, we would want to have applicants access NSUF capabilities or we want them to have the proposal to use those capabilities, not for everything, but some of the NSUF have capabilities to be used. That could be High Performance Computing capabilities here at INL or any of the other instrumentation that we have around the complex.

Q: For NSUF-1.3, does the scope require neutron irradiation or will ion irradiation be sufficient?

A: For concept demonstration that will be fine on a radiation will be all right.

Q: For NSUF-1.3, since R&D is funded by NSUF, does 'Pi-ship' or 'co-PI-ship' count toward ones limit of 6 total project submissions NEUP projects?

A: The answer here will be yes. And the reason for that is it's an NSUF-1 scope meaning the lead PI will be conducting research and development activities.

Q: For NEET-1, are there any techniques involving the melting of materials or are those excluded?

A: Any techniques are open.

Q: Would you be interested in-situ HT measurements of thermal expansions of ceramics in 3D?

A: Not this year.

Q: In one of the presentations it said different material characteristics are required for various reactor concepts fast vs. thermal. Can you elaborate more on that?

A: I never made that statement but it's but what it is true. I mean there's there's different for example in that in cladding. Under fast fast flux that you have swelling in the austenitic type steels for the cladding and where you have reduce swelling and ferritic martensitic. So you have different fuel behavior under fast versus thermal where the temperatures can be different and the thermal gradients are different within the fuel or fuel pin. So there are a couple of examples of difference in the thermal vs. fast and the material or fuel types.

Q: For NSUF-1.3, is a separate application for NSU F access needed.

A: It's one application. There is an expansion of the page limit when you get to the full application up to 15 pages so you can include additional details about the NSU F scope. So you will need to submit a letter of intent that includes both the R&D in the NSUF descriptions as you go through the process.

Q: For NEET-1, and NSUF-1.1 what surface modification techniques are especially sought? Are you interested in where resistance techniques? Coatings or fatigued or all?

A: All.

Q: Also for NEET-1, are you interested in geo-polymer ceramic composites which are made from like-cements but materials that can reach 1200 C?

A: I have not talked about that. But yes, why not?

Q: For NSUF-1.2, are you looking for new qualification inspection technique development or use of existing inspection standards?

A: It is no inspection standards for this specific techniques, advanced methods for manufacturing. So we are interested in any inspection methods and methodologies or qualification or standards. We definitely are interested.

Q: There's a clarification on the fast versus thermal reactor question. The clarification is what is the focus is it on fast or thermal reactors?

A: I don't know where this question is directed towards. If it's 1.3, there is no thermal or fast reactor directive for this for the advancement of material. So you can pick your reactor pick the material and and the environment that you're working in. I don't know about I don't believe I don't believe tan cell with the advanced manufacturing has a director for thermal versus fast.

Q: For NSUF-1.3, is the application process like NSUF-1.2 or is it just one pre-application needed by September 24th?

A: The NSUF-1.3 is an NSUF work scope meaning it requires a Letter of Intent and follows the process of other NSUF work scopes in the past. If you're unfamiliar with that process, you can refer to a past FOA or you can look at the new FOA when it's released in the next few weeks.

Q: For NEET-1, are you interested in surface modification with novel material or improvements made in current materials with advanced manufacturing?

A: Both.

Q: In NEET-1, are you looking for inspection of clad structures or does this relate to all nuclear structures and materials?

A: We are looking for any qualification or methodologies regarding any advanced methods in manufacturing, not just for cladding.

NE-3: Transformational Challenge Reactor R&D

Q: Will thermal hydraulic challenges be of interest?

A: The work scope has not been finalized. It is under review and I cannot tell you the specific topics at this point. Please wait a couple of weeks and then email me or Sherry. We'll be more than glad to answer you.

Q: What labs are involved in TCR?

A: TCR is Oak Ridge National Laboratory-led program with partnership of Idaho National Lab and Argonne National Lab.

Q: TCR is gas-cooled reactor. So is this study only relevant to gas-cooled reactors?

A: If it is about the core performance, we will publish our work scope in detail. And yes, it's a helium cooled gas reactor.

MS-NE-3: Mission Supporting Grand Challenge

Q: Would you support the development of new methods for accident tolerant fuels preparation, an example is uranium silicide?

A: I mean, I don't want to say yes or no to any ideas right now. And I apologize. I haven't read thoroughly all of the other work scopes, but obviously advanced fuel development accident tolerant fuels within our existing program, we're pretty focused on the types of fuels that can be deployed in the near term. I know they're also looking at longer term options. So if that's something that that does not fit within the existing programs or existing work scopes, I think it would be fair to submit it here. I would encourage you first engaged the Advanced Fuels Point of Contact to get their thoughts on that.

Q: Will fission product transmutation be considered as part of closing the gap?

A: I mean there are a lot of companies and technologies that could utilize transmutation fuel and closing the fuel cycle and recycling. So, we're doing some work in that area. It has not, over the last couple of years, been a major priority, but I think that is something we continue to be interested in. And again, I'll refer to our material recovery works scopes. I'm not exactly sure the specific language they're looking for this year, but just encourage you to take a look at that and see if what you're thinking about fits there. And if not, you know, this could be an opportunity.

Q: Would new measurement techniques that would significantly improve monitoring crucial plant components and therefore reduce maintenance costs be of interest?

A: Again, potentially, I mean a lot of these ideas so far at least, at the level of the questions are being asked, sound very similar to things that were doing. So I'm trying to be careful

not to say yes or no here but most of these ideas that have been brought up so far sound very similar including this one where we have work scopes in multiple areas developing instrumentation and have a specific program under our NEET program working on this. So again, we'll encourage you to look at those. This is not intended to be. We didn't ask for this very specific thing this year, but really if it's within an existing program. We're looking for things that we really aren't doing anything in. So I leave that for the applicants to decide. We are kind of sounding like we're getting down the road of I don't quite fit in this work scope, I'm going to try this other one instead. That's not what this work scope is intended to be.

Q: Approximately how many awards will be made under this work scope?

A: I don't know where the budget will end up. We will balance it between the number of high quality proposals and the overall budget that NEUP gets this next fiscal year, which we still don't have a final number on that. I would say up to a couple or a few.

Q: Does this scope include designing new fuel with potential for significantly higher burn up? And what kind of TR is expected?

A: I think it again it would depend on how innovative and different the concept is. We have a very robust fuel development program where that would be the first place I would recommend you look. But, if this is something that's very innovative and novel that we aren't currently working on or haven't considered within our main program, then it could potentially fit here.

Q: Could you talk to TR levels?

A: One of the the main goals here is things that can have a big impact and the sooner they can have a big impact the better but I don't want to bin this work scope in a particular TRL level. I think anything that is innovative and disruptive and could be a big game changer for nuclear is welcome. But also realize that the challenges the current fleet is facing are immediate. So a solution that's proposed that is five or ten or even three years down the line may be too far away. Similarly, we are being pushed and pushing ourselves to get advanced nuclear technologies to market as quick as possible. There's pending legislation, the Nuclear Energy Leadership Act, that would in fact require us to demonstrate two reactors by 2025. So we really need to be moving on that now and are probably behind schedule actually. So keep that in mind. It does not have to be late TRL, but the sooner it can be impactful the better.

FC-4: Spent Fuel and Waste Disposition

Q: For FC 4.2, what type of steel are you interested in?

A: Well, it's the stainless steel from which the canisters are fabricated. It's the canister walls we are looking at.

Q: Is it possible to propose a project that is scheduled for less than 3 years?

A: Yes.

Q: Is novel cask material of interest?

A: No, we're not looking for the actual cask material. The production for the cask material as its produced by The cask suppliers No the cask but rather the canister actually. It's using the canister using the existing material of the canisters are fabricated from.

Q: Are international collaborations welcome in these work scopes?

A: Yes. I think there are. NEUP and NSUF dollars can't go overseas, but you can partner with an international collaborator who can make some type of an in-kind contribution or is an advisory role.

Q: As for the technique mentioned in FC 4.2, are modeling and simulation of interest to the program?

A: Yes, modeling and simulation to support the the yes the technology. Yes.

Q: With regard to storage. Are you looking for solutions applied to existing/fielded canisters or new storage canisters?

A: Both. If we can apply some sort of inhibitor to the new ones that would be useful, and the existing ones, which is probably more of our focus. In some point in time we're thinking that we might have to relocate the existing ones and it would be good at that time to have some sort of inhibitor to apply to them. I am not particularly looking for application in-situ with the canister and storage inside the concrete overpack. I'm more focused on something at a time when we take the canister out of the concrete over pack to relocate it somewhere.

Q: For FC-4.1, are you interested in interactions of microorganisms with materials in a generic repository situation?

A: The answer would be yes to that to the extent that it would need to fit the other aspects of the existing call. But yes, definitely.

Q: For FC 4.1, would you consider metallic waste forms, or is it just ceramic and glass waste forms?

We're actually, our greatest interest would be in glass and also in existing spent fuel uranium oxide fuel. There is the separate waste forms call that we'll be looking at experimental and unproven waste forms will look at them, but they would be likely to be referred over to that that call instead.

Q: For FC 4.2, what TRL level of technology is the best fit for the call?

A: I think we're at the early stages.

Q: For FC. 4.1, are cement based materials/barriers of interest?

A: Yes.

Q: Would optimization techniques to expedite removal and clearing decommission sites be of interest?

A: Not in this call. No.

Q: Are novel concrete materials for the overpack for disposal with physics based modeling of long-term aging considered?

A: It's not a high priority, but to the extent they fit the call we would definitely take a look at them.

Q: In the language of FC-4.2 in the draft work scopes, you mentioned sprays, coatings, and weld deposition techniques. Are you placing more weight on these three techniques or other techniques will be equally considered?

A: We're not placing more weight on these techniques. These were just some examples that would probably be more of more interest.

Q: In FC.-4.2 is low-level radiation waste being considered?

A: No.

Q: In FC-4.1, are you only interested in spent nuclear fuel research or are single phase ceramics are multi-phase ceramics as potential waste forms also of interest for the program?

A: Our primary interest is in disposal of existing waste or treated forms existing waste. We recognize that much of the spent fuel in this country will be disposed of without treatment, without processing. So certainly spent fuel is a high priority. Existing plans call for vitrification of tank waste, so that's a high priority. We will certainly consider viable alternatives to vitrification waste forms, but our interest is on existing waste rather than future waste from hypothetical future waste streams.

Q: What kind of buffer materials are you interested in?

A: Bentonite is a standard. We're interested in buffer materials that have a high longevity, high durability over geologic time, hundreds of thousands of years that are sorptive and are a very low permeability that are tend to heal their own fractures and that are capable of

withstanding temperatures up to 150 or 200 degrees C. You won't find that in the call. But since you ask there, there are some answers to that. Bentonite meets all of those except for the high temperature end of the range.

Q: For FC-4.2, what's expected for the proposals to this call that's different from previously supported projects such as the cold spray projects funded in FY 2018?

A: It's very similar to those. cold spray was just one type of an inhibitor. The cold spray that we were looking for there was more focused on a pair of existing cracks and what we're focused more now on is inhibiting the initiation growth of the cracks and pits. So there the nuances are all different.

Q: Are new materials or barriers for deep borehole disposal of HLW of interest to FC-4?

A: The answer would be only to the extent that they were also applicable to a deep mine repository.

RC-1: Innovative New Structural Materials for Molten Chloride Salt Fast Reactor Applications

Q: Do materials include surface coated ASME code qualified metallic alloys?

A: The scope does not include the development of clad materials.

Q: Are you more interested in advanced Ni alloys or HEAs for this call?

A: We don't have any preference. We are looking forward to the university community to come up with new advanced alloys that can fulfill the requirements that we described in the scope.

Q: How many awards are anticipated and are you interested in different materials than proposed in the past? There is no way of knowing the details except the public published abstracts.

A: As for the number of proposals that we will be funding. At this point, we don't know that because this would be funded with fiscal year 2020 funds. Congress has not yet made their appropriation. So at this point, I think it's too early to say how many there will be. I would estimate there would be one to two but it's too early for any sort of sure number to be said at this point. And yes, we are open to new ideas. That is that's the goal here. So whether it be a new idea or building on an old idea that hasn't been fully investigated either one would work.

Q: Are you interested in high entropy alloys or new nickel alloys?

A: If they would meet the requirements, we are interested in both. Is there anything you want to add to that Sam? No, I think that that is what we wanted is that there are some of the performance criteria we we don't know which will work for the molten core. IWe would like to have the help from the universities to solve our help us to address is a challenging issues. So, if high entropy alloy is something the PI can demonstrate that it will work. We love it. We're looking for ideas. Obviously, the nickel alloy is known to be sort of relatively good for chloride salt or resistance, but then we have the other performance metrics in terms of irradiation etc. So this is no secret that this is a very challenging problem and we are really soliciting any and all ideas.

Q: Why are ceramic materials excluded from the work scope?

A: Because of our ability to only fund a few of the proposals, we're focusing on metallics at this point. So, in the future we may focus on different areas, but that's our focus right now.

And also that we are looking at the structural materials or some structural components applications. So, obviously, ceramics will have a lot of those good attributes that we are looking for, but then it brings in other the issues in terms of replicability, joining to other components since it cannot be placed in the reactor all by itself. It has to link to other components, it could be metal. So that's the reason why we want to focus more in terms of metal for this time.

Q: What's the most important temperature range for these work scopes?

A: These would be high-temperature reactors. I don't know if I could specify what's the most important temperature The slide 9, there's no temperature information. But I think that in some other slides we said that we would like to have a good high temperature range up to 900 to 950C. That is a goal. For metallic systems, we know that 1000C is not something that is easily achievable unless that we will introduce our issues in terms of how we construct a structural components. So I would say that 950C, I would love to have it, but it has to be considered as a goal and not a requirement. So anything for 950C and below, we would love to have it. The current materials properties: my understanding is that there are some MSL developers are pulling materials off-the-shelf, qualified materials, like 316 stainless steel, so the temperature range for that will probably be comfortable to use up to 650C for 316 stainless steel for this type of a reactor concepts. So, we want to develop some new structural alloys that can have a better temperature performance then the 316 stainless steel. So some of this is the boundary to 650C. We already have structural materials that we think that we can use. So any sort of new structural materials will probably be have to be greater than 650C. We're looked at 950C as a stretch goal so closer to the higher temperature side.

Q: Is the focus on the weldment/the joining of different alloys?

A: Well, I guess it there be two for one the first issue would be welding the new material to itself in order to fabricate components. That would be the first focus. I think at this stage.

So the way that we construct is we have two components that we can sort of mix and shape and sooner or later we have to use the welding process. So I would look at that into tiers. One is that I would not worry about welding if I don't have the base metal that is capable to begin with. So some of the emphasis will be to first find some base metals that will match up with some of those are performance criterias and metrics that we put out. If that is successful and that alloy is not weldable, then we have an issue as well. So I sort of look at that as first is the base metal properties and then if we can achieve that then we ask the next question is that weldable? So I would go about in top of this order.

Q: Is the focus on alloy 709 or could it be?

A: I don't know but alloy 709 has very high chromium content. So whether or not that is optimum for a chloride salt application, I don't know. That material definitely has higher temperature performance than 316 stainless steel in terms of the high temperatures strength, but I don't think that we have too much information in terms of the corrosion resistance, etc. So you'll have put this together in terms of why you chose that and why they propose some class of materials that they want to work on.

So the focus again is not on a particular material but material that can meet the performance criteria. So we don't have a particular alloy in mind. We just want the focus on performance.

Q: There have been Awards on HEA and ODS in the past with those still be of interest?

A: Again, if they meet the criteria, they would they would be of interest. As Sam said and with the prior with the earlier question on HEA, as if they meet the criteria if they can meet the performance criteria. We're certainly interested in them.

Q: Would you consider a proposal with only theoretical work?

A: I think a proposal with only theoretical work would be very challenging to prove that it would be successful. Part of the the NEUPs goal is research and development to show that the concept would work. I think it would be a very challenging way to go.

Q: Can you identify the radiation damage limits in DPA?

A: So my earlier chart had some data on dpa. It could go all the way up to 200 dpa as you can see on this chart the third column from the right.

Q: Is there any international collaboration allowed or encouraged?

A: I don't know what the rules are for the NEUP of that would be more of it.

International collaborations are encouraged as a general rule for any NEUPs. They cannot receive US Department of energy funding though. So it would be on a

no cost basis that an international collaborator could participate. The UK research council's have participated in past FOAs but my understanding is those discussions are still ongoing for this FY 2020 FOA.

Q: Are you looking for the development of new model alloy systems that can be engineered and code qualified in the future or are you more interested in engineering and processing of existing alloys so they can be code qualified right after the project?

A: I wouldn't limit it to either one of those and we're focused on performance and the information that we have with research that's been done in the past. It's probably going to more be the latter, something that's requires further development. But again, we're focused on materials that that could work in these environments. So whether it be a freshly newly-designed material or something that's been developed for another application that would work here, either one would meet the need here.

Q: Is IASCC and important criteria to be addressed?

A: Yes, the irradiation assisted stress corrosion cracking phenomena is more well developed or understood or observed in something like the Light Water Reactor in the materials. So as far as the molten core, fast reactor applications, we have a less information on IASCC. Those are the type of things that we embedded in the performance metrics as to things that we were concerned about if they do happen. Therefore, if that is demonstrated to be a degradation mechanism then we would like to have the structure materials with new alloys to be resistant to those type of degradation modes. This is also material dependent. So yes generally speaking we want to assess and are concerned about those type of potential degradation modes.

Q: How important is it to conduct in-situ mechanical testing in molten salt environments?

A: At some point that testing will need to be done. If the PI proposes other methods that they think they could prove the concept that isn't required to do in-situ testing we're open to it. But at some point that type of testing will need to be done.

FC-1.3: Waste Form Development

Q: Should we fabricate glass with or with out cold/hot simulat waste streams? What do we need to consider: TCLP test, retention rate for some fission products?

A: Cold simulants only. Other tests are important. DOE will perform ASTM C 1308, 1220, and 1285

Q: The purpose is to develop a highly durable and easily processable phosphate-based waste glass, does it mean the application is to find new composition glass or test the known phosphate waste glass?

A: Whichever you prefer. We don't have a preference.

Q: For FC-1.3b (Salt waste recycle and immobilization), would there be any interest in non-phosphate-based waste glasses?

A: The call specifically asks for a waste form from a phosphate dechlorination process. That selection was made primarily due to the kinetics of dechlorination by this process compared to your zeolite method and for the relative ease of recycling the ammonium chloride into a ER feed material UCl₃ (compared to HCl). So, I recommend that the phosphate waste form be the focus of any proposal.

Q: The call also mentioned national lab is developing dehalide waste stream and references are available. Would you mind to send me the references?

A: This is work that was generated by a team from ANL, INL, and PNNL (each with their specific roles). The outcomes can be found in the following technical report: PNNL-28745-Electrochemical Salt Waste Form Development: A Comparison with Iron Phosphate Glass.

Q: For FC 1.3B, the call indicated to seek proposals for a phosphate glass waste form? Will the call be interested in ceramic or glass-ceramic composite waste forms?

A: We are open to all phosphate based waste forms so long as they can "...be processed efficiently in existing waste glass melter technologies and result in acceptable glass when slow cooled in full scale waste glass canisters." I would say glasses or glass ceramics would be the primary intent.

Q: Both work scopes have a specific target waste stream. FC 1.3a has the caustic scrubber solution and FC 1.3b has the phosphate liquid containing fission products and actinides. Where can we find the composition of these wastes?

A: Below are the answers to your questions regarding the composition of the waste as described in the FC-1.3 a and FC-1.3b work scopes. Hope this helpful. Please free to ask additional questions.

FC-1.3A

The following is an estimated (and very simplified) scrubber bottoms composition.

NaOH – 0.2 M

NaI – 0.03M

NaCl + NaBr – 0.1M

Na₂CO₃ – 0.6M

NaNO₃ – 0.03M

NaNO₂ – 0.06M

All of these values are approximant and could vary by at least a factor of 3 or more depending on the operating conditions of the scrubber and any proceeding unit

operations. In addition to these, there will be some quantity of other radionuclides that arise from the dissolver.

We recently published a report on the testing of a combined scrubber system. This report can be found at the following link:

<https://info.ornl.gov/sites/publications/Files/Pub117828.pdf>

FC-1.3b

Below are the salt simulants that Steve Frank (INL) made for our work on the electrochemical waste forms. Let me know if you need anything else.

| Additive | ER(SF) | ERV2 |
|-------------------|--------|-------|
| LiCl | 33.09 | 32.32 |
| KCl | 40.52 | 38.68 |
| NaCl | 9.88 | 9.00 |
| CsCl | 5.18 | - |
| CsI | - | 7.00 |
| KI | 3.09 | - |
| SrCl ₂ | 3.13 | 3.00 |
| YCl ₃ | 1.55 | - |
| LaCl ₃ | 1.55 | - |
| CeCl ₃ | 0.002 | 5.00 |
| NdCl ₃ | 2.01 | 5.00 |

[ER(SF) salt]

B.J. Riley, J.D. Vienna, S.M. Frank, J.O. Kroll, Z. Zhu, N.L. Canfield, K. Kruska, D.K. Schreiber, J.A. Peterson, J.V. Crum, "Glass Binder Development for a Glass-Bonded Sodalite Ceramic Waste Form," J. Nucl. Mater. 489 (2017) 42-63.

[ERV2]

W.L. Ebert, B.J. Riley, S.M. Frank. 2017. Test Plan for Salt Treatment and Waste Form Development. NTRD-MRWFD-2017-000191. Argonne National Laboratory, Lemont, IL.

In addition to the salt compositions from Kimberly on FC-1.3b, we're most interested in immobilizing the dechlorinated salt with phosphate. Example compositions for that are attached.

mass basis

| | | | | | | | | | |
|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| | P2O5 | Li2O | K2O | Na2O | Cs2O | SrO | Ce2O3 | Nd2O3 | Sum |
| DPF1 | 0.6830 | 0.0681 | 0.1461 | 0.0285 | 0.0227 | 0.0117 | 0.0199 | 0.0201 | 1.00000 |

DPF3 0.6949 0.0655 0.1406 0.0274 0.0218 0.0113 0.0191 0.0193 1.00000
DPF5 0.7618 0.0511 0.1097 0.0214 0.0170 0.0088 0.0149 0.0151 1.00000

Q: You mentioned some references available on the scrubber process. If so, would you mind to share some information about the scrubber process?

A: We recently published a report on the testing of a combined scrubber system. This report can be found at the following link:

<https://info.ornl.gov/sites/publications/Files/Pub117828.pdf>

Q: For the requirement of providing test samples the national laboratories for testing. Do we have to put funding in the budget for national laboratory testing and characterization?

A: I believe the answer is no.

Q: Are there descriptions of initial waste stream compositions?

A: We have some literature that we can send out if they would send us a quick email.

Q: For the university/national laboratory partnership must the 20% funding go to the national lab for testing?

A: No.

Q: Is there room for modeling and simulation work on both areas or is the call aim to experimental proposals only?

A: Experimental proposals.

Q: Has there been any recent review of halide waste forms?

A: Yes. again, we can send out some literature if they like but yes, there has been. The most recent is by Riley et al, I think.

FC-2: Advanced Fuels

Q: Would you please recommend some contact for the AFT vendors as potential collaborators?

A: ATF industry lead contacts to obtain information on ATF concepts:

GEH: Russ Fawcett, (GE Power) Russ.Fawcett@gnf.com

Framatome: Jeffrey Reed, jeffrey.reed@framatome.com

Westinghouse: Boylan, Frank A. boylanfa@westinghouse.com

Q: For FC-2.1, is it required to list fuel industry partner as a co-PI?

A: It's not required that the fuel industry be required as a co-pi; but, conveying to us that one or more of the ATF vendors finds the approach of potential value is an importance relevance issue.

Q: For FC 2.3, The scope talks about exploring a diverse set of fuel design parameters. Can we get a list of fuel design parameters that are of interest?

A: We can certainly generate a list but I mean there the classical fuel performance parameters, you know properties especially. The big ones are already listed: cladding deformation, fuel swelling, fuel axial growth is part of that gas release, of any kind that may be part of it, microstructural characterization of the fuel cladding, any sort of microstructural features that can be measured quantitatively, grain size, porosity, things like that are of interest. Those are the big ones. There could be other things that we could think about. One thing that comes to mind is just imagine someone at a hot cell with their manipulators trying to handle 20 of these things.

Just think of the human factors involved with the challenges of doing whatever x-ray tomography or whatever it is you're doing There could be opportunities for just a basic mechanical engineering improvement of the process.

Q: Moving back to slide four for NDE testing, are these coatings metallic?

A: Yes, not all metallic but most of them are metallic, chromium ,for example, but there also is an advanced one from General Electric that's more in the ceramic area. The other two vendors are chromium type.

Q: Is the difference in scope for FC-2.1 this year compared to FY 2019 only that it does not need to be integrated into a hot cell?

A: It's more than just that. Last year's one was a post-irradiation focused item for hot cells. This is something the vendors could use as a qualifier of what they're fabricating. So this is clearly a difference in that it's unirradiated and post-fabrication. I'll add that high throughput is the ultimate goal. So as fabricated full inspection non-destructive is the goal on this.

Q: Is the coating only on the OD?

A: Yes, it's basically a coating on a zirc cladding.

Q: Do we have access to both ID and OD of the tube?

A: I think that's something you'll have to discuss when you contact the vendors. If you need it for your technique I imagine they would they would could make something available, but that is something to be discussed.

Q: On Slide 10 for FC 2.3. What are the exact materials to be tested?

A: It's a wide range of any fuel. The idea is we're taking any rod-shaped fuel and miniaturizing it so we can do accelerated testing. This could be zirc, silicon carbide, fast fuels, metallic fuel, ceramic fuel, fast spectrum, thermal spectrum, etc. It's pretty much limited by the just the shape, the cylindrical shape, because you have to get the cylinder in there, get the gas gap, get the sodium bonding, to get the right thermal spectrum and then get the linear heat generation right. So the sky's the limit as long as it's a rod. We expect demonstration on surrogate specimens. So we don't expect you to do any irradiated fuel type specimens.

Q: In FC 2.1 does the NDE technique need to be portable or be able to survey the entire length of the fuel cladding?

A: I don't know if there's a requirement for portability, that's something for you to discuss with your partner. It's important that it can help them qualify what they're doing faster than what they might have considered in the past.

This was an area that was actually proposed in principle by the vendors or the industry. So they are looking for a technique that would be installed in their fabrication plants. So I don't think portability is an issue at all. But in relation to inspecting the full length of the coded area, yes, that's exactly what would be needed.

Q: For FC-2.1. What is the smallest expected flaw size that the NDE technique must be able to detect?

A: Again, my answer to that is find out what the vendors think they can do right now and how they want to improve on it?

Q: For FC-2.2 the gain Workshop identified several industry needs most of which involve the radiation effects, but the FOA specifically states that the radiation effects are outside the scope. So is there another specific need that DOE is targeting to fill/understand what this call?

A: Yes. So like we discussed on slide six there are three areas that we think would be appropriate to be done at a university: chemical compatibility between the UN Fuel and the LED coolant, compatibility with the steels or the aluminum form in steels, as well as fuel property measurements to fill gaps in existing databases. So there are additional areas outside of irradiation.

Q: For FC 2.2, are high throughput measurements of microscopic thermophysical properties to predict bulk properties of interest?

If you're talking FC-2.3...If that's the case high throughput is of interest because we expect to have a large number of samples. So yes, decreasing the time of any kind of analysis is of interest, if you're talking for the micro rodlets.

Q: Is there a good place where material modeling can fit in FC-2.3?

A: Absolutely, the PIE is supposed to confirm or inform material modeling. There are some this needs to meet up with advanced modeling and simulation simulation activities in the area of fuel fuel performance. That being said the call is really about experimental techniques for these specific type of samples. I don't think we would be looking for a proposal that was just modeling. That would not address the call. We're just looking PIE techniques. All I meant to say is every PIE technique should ultimately yield data that will either confirm the results of a model or inform the modelers. We limit this to PIE techniques.

Q: For FC 2.4, does it need to be compatible with TREAT or ATR?

A: The most of what Halden did was with steady state and power ramping. We're mostly interested in ATR, but we're open to open to TREAT applications to but the focus should be the steady state of radiation diagnostics that that was conducted in Halden.

Q: For FC-2.5, TREAT testing. What fuels are you interested in? Is uranium silicide of interest

A: Since we're talking separate effects testing, I'm uncomfortable saying what fuels were interested. I like to see things at generally at smaller levels, of course integral tests. It should be a fuel that is of a high-interest, high programmatic interest. But the main thing is separate effects testing, so that's kind of at the sub-fuel level. Well, I would say that I would say that silicide is of interest so that's not ruled out.

Q: For FC 2.2, will you support the development of new innovative and economic preparation methods for UC or UN?

A: I think we would but I'll let Andy weigh in on that. I think that is an area where there could be some innovative work done. The big issue for this call is convincing the reviewers that the problem you're looking at is a high priority. There are many different things that you can look at for UC and UN and the different problems that are outlined on the slide. So, you know making the case that fabrication is truly one of the big factors impeding deployment and advancement of either of these fuels, if you can do that and then propose a better way than the reference techniques that are available that could be tractable in my view.

Q: For FC-2.1, Will the ATF vendor be a collaborator on the proposal?

A: They know about this and they would have to be interested or it wouldn't be welcome. So, they know about we're doing this as Steve mentioned earlier. We're doing it as a result of an industry representative group telling us this is of interest.

Q: For FC-2.1, does NDE include only non-contacting methods. What about contacting methods with very minimal effects?

A: That doesn't sound under unreasonable to me.

Q: For FC-2.1, are you looking for post-process NDE techniques to evaluate coding or techniques that could be used during processing or both?

A: If post-processing means after it's been fabricated, that's clear to me. Whether it would be useful while it's under fabrication again, I would forward that question to the vendors of what they're interested in. It might be useful, but I my initial assumption, as I understood this, was post fabrication and pre-use. That's right, in my discussions with the industry folks in this area, what they're looking for is a final inspection of the as-fabricated coated tube. So they're not looking for process monitoring. They could talk to the vendors about whether or not that's really of interest but what this call was written to address was a final inspection of the as-coated tubing to determine whether or not it meets specification.

Q: For FC-2.1, can you identify methods used by other industries that aren't applicable for this application or reasons why they might not work.

A: That sounds interesting. That's it doesn't sound wrong to me. But again, the main thing is to propose it or at least check in with the vendors. If I understand it, you're saying if there's some method that's been developed elsewhere, let's say fuel cladding, and you think it might be applicable that could be interesting.

Q: For FC-2.1, what are the typical inner diameter outer diameter and length of the test tube?

A: This is again a repeat of what we've heard earlier. I think that's again the type of thing you want to check with the vendors. Obviously, if it's post fabrication, you know the length of a typical LWR assembly pin.

I can understand why you need that information for some techniques, but again, run that by the vendors.

The the cladding dimensions are not a secret. I mean they are publicly available: PWR BWR cladding tube diameters.

Now, each vendor will have the thickness of the coating they're trying to apply that will be vendor specific but the tubing is just what is in common commercial use.

Q: For FC-2.2, the chemical interactions could be an issue for MSRs but not GFRs. The uncertainties for UC and UN are in their irradiation properties. Why aren't you recommending your radiation and PIE?

A: We don't think that with three year time frame and the \$800k maximum that you will be able to do neutron irradiation and we believe that ion irradiation for fuel is less useful than neutron radiation would be. So we're keeping irradiation outside of the scope of the call.

Q: Is FeCrAl being considered under FC-2.3?

A: Yes, but I'm not aware of the manufacturing challenges and making FeCrAl at that small of a dimension.

Q: For FC-2.1, what is the expected scan speed of the testing?

A: Well, again, that requires the vendors requirements. I think the word rapid assumes that it's not going to be an overly long time. Remember, you know how many pins are in an assembly? There's a huge amount. So clearly I think a speed is going to be a selling point on whether this is interesting to the vendors.

Q: For FC-2.2. are you considering fuel surrogates for these studies?

A: Well, we specify UC and UN fuel. So if you can find something that behaves like they do, then sure but we're really interested in the UC and the UN applications.

Q: For FC-2.1, do you have contact information for the vendor so we can get in touch to devise a plan or to discuss proposals?

A: Well, we've listed the three names there. And, by the way, at was going to say later on at the end of this presentation is a list of our contact information. So, if you don't know who's already the right people we have the contact information. We've been pleased to give it to you just send one of us an email.

Q: On FC-2.3, do you need to demonstrate the testing methodologies and in a hot cell environment?

A: No, but I expect you to work closely with the technical point of contact so that you're aware of the realities of the hot cell environment, so you don't create some giant truck of a thing and be surprised why you don't get accepted.

Q: How many awards are expected under FC-2.1?

A: We we try to evaluate everything. You know, what happened last year. There was some limited amount of what we can do. A lot hinges on the funding that will be given to NE to cover these, you know, all the programs contribute and last year some money had to be needed for some other efforts and all. So my feeling is that it's probably a very it's going to

be limited again and hopefully it won't be as limited as last year, but that's why it's so important to have somebody on board that it's easy for us when we do a relevance review to understand. So I would like to say that the value of the proposal is more important than the number but the reality is, you know, we have five areas. They're all interesting. Last year, we were lucky to have one or two in each one of them. So that gives you an idea. It was tight last year. We hope for a better freedom this year.

FC-3: Materials Protection, Accounting, and Control Technologies

Q: Where does this FC-3 scope divert from the RC-1 scope which is on MSR materials, in other words, what are the differences between the two and how many proposals would you support?

A: So, my understanding of the the other area that is more focused on basic material research like understanding salt chemistry. I don't have in front of me, but I'm fairly I'm fairly certain that is the primary concern in that area. There could be some overlap but from MPACTs point of view, we're really looking to focus on technology for addressing safeguards needs so accounting for essentially accounting for actinides in the salt. Although there are different ways you can get there with not necessarily direct measurement there are indirect ways that you could also reach that. So I would say that they're different in the sense that one is materials and chemistry research versus MPACT which is safeguards focused, but there could be some potential overlap.

Q: What TRL levels are you interested in?

A: So let's see. That's a good question. In the past the program has not explicitly defined the TR levels we're looking for but I believe it's we usually look between like on the low end it's around 3-4 up to if I remember correctly around 7 on the high end. I think so essentially a pretty big swath of stuff in the middle. I would consider I would consider accepting slightly lower TRL projects for this proposal because I think it's really important to get you know, some fundamental research done that is creative and unique that could fund the next generation of safeguards technology. So I would say don't limit yourself too much but that's my wishy-washy answer that question.

Q: Would novel application/algorithmic enhancements of existing MPACT supported instruments (e.g. the high dose neutron detector) be considered sufficiently novel and the distinction are looking for here is incremental improvements versus improvements of existing tools to extract new information?

A: If you think you have a good idea, I think you should submit a proposal. That being said if I had to choose between an idea that was new to me and I thought had potential versus incremental improvement over something MPACT is funded for a number of years, I would probably lean towards a newer proposal.

Q: Where modeling and simulation could play a role in the program? What National Labs will be appropriate Partners in a proposal?

A: A lot of our modeling and simulation work is done with Argonne or Sandia and currently Argonne has modeled some of the physical facility layouts and some of the batch process modeling to support a notional pyroprocessing facility model. Sandia has a lot of expertise in safeguards and security modeling. So those would be two good places to start but Oak Ridge also has a lot of experience modeling as well. Especially for molten salt related items. So you have a lot of good options there.

Q: Will there be opportunities for greater funding in the future for successful proposals?

A: For all of the FOA areas, each application for each fiscal year is a separate distinct application these programs (the NEUP, NEET, and NSUF programs) do not typically do follow-on funding. Everything here is competitively funded on a year-to-year basis. So there are programs that do follow-on scopes, based on results that they receive from projects, but they are always competitive in nature in the CINR.

Q: Can you please clarify if modeling and simulation is not a focus of this year's call?

A: Similar to my earlier answer which is not going to give you a real immediate 'Yes' or 'no'. I would prefer that this call focus on hardware and detector design or material development to support detector design. However, I think we may have the flexibility to fund a novel idea in modeling and simulation as well. So those are my thoughts.

Q: How many proposals do you anticipate funding in the area?

A: I don't have an exact answer but I think we can probably expect between one and three probably. If we have three very strong proposals at 400k I can probably make that happen is my feeling. So don't over promise that but I think so.

Q: There is some interest in potential non-proliferation and safeguard applications of remote reactor monitoring. Is this topic considered relevant to the call?

A: It's a good question. So I feel like I've seen some of these proposed for NE-20 work. I have to admit it isn't directly on my radar as being something I'm explicitly looking for. That said, if it applies to advanced reactors that are similar to or could be similar to those that our U.S. industry is building. I would say you should absolutely submit a proposal.

NEAMS- Nuclear Energy Advanced Modeling and Simulation, and MS-NE-1 and MS-NE-2

Q: For NEAMS-3, and it says which salt is preferred chlorides or fluorides?

A: I don't think there is a preference. The one thing that I would ask you to do, and this is in the scope of work that we that we put out, is very clearly identify which salt: the exact composition, the exact properties, and conditions that you're going to that you're proposing. There's not a preference on which one you use but be clear about what it is and what you're going to do with it.

Q: IRP-NEAMS-1.2 is titled as multiscale nuclear fuel performance. But the last priority mentioned proposal should focus on multiphysics rather than multiscale methods. Could you clarify this?

A: Okay. As opposed to focusing on the progression from atomistic scale to engineering scale that's well in hand within the program. So, work in this area should focus rather on the engineering scale code applications models into the engineering scale code BISON and it's coupling to other codes. So that's the multiphysics versus the multiscale.

Q: In NEAMS-1, what is cut off number of multi-group cross section 100 or 1000?

A: I don't know that we have a cut-off but we should respond in writing.

Q: Is NEAMS to mainly an experimental work or are you also looking at functions modeling and experimental data analytics?

A: Yes, I think the answer is that it's the latter. It's both the experimentation and getting experimental data and folding that into the models. So not just one or the other it's going to need to involve both.

NE-2: Integrated Energy Systems Design and Modeling

Q: Are there examples of Modelica codes used by the lab team for IES available to the public?

A: We use the transform library from ORNL, which is open source, and some of our reactor models are there too. Please contact the technical lead if you need additional information.

Q: What TRL do you require in the technologies proposed?

A: I would say that there's probably not a specific requirement for TRL level. Obviously, the further along it is the better because then it would be closer to actual deployment or commercialization. However, especially through a university program we're interested if someone has a great idea we are interested in hearing it.

Q: Is the call for experimental work or modeling, or both?

A: Both.

Q: Are Generation 4 reactor systems considered?

A: I would I would say that they are were fairly flexible so long as someone has a novel idea for how to integrate nuclear with the Integrated Energy System for water production. Yep.

Q: Should the project consider existing reactor technologies to be U.S. reactor technologies or is coupling with a non-U.S. technology in the scope?

A: It would need to be a domestic reactor technology.

RC-4: HTGR TRISO Fuel Particle Materials

Q: For RC-4.1, is a multiscale multiphysics model in MOOSE, MARMOT, BISON a valid approach? Or is there a recommended code to use on this side?

A: Not at all. We do not want to prescribe any codes of this point. We welcome the proposals that use the latest greatest, you know that their legacy in the form of PARFUME codes that might be similar to that outside, but we actually encourage people to try and use the latest needs develop tools if they can.

Q: For RC-4.1, can you please elaborate more on the statistical analysis buffering shrinking is a function of time irradiation and various boundary conditions?

A: At the end of the day this stoastic codes are all statistical based. Some of the statistical engines like Dakota or RAVEN is capable of performing many parametric studies using reduced order models, for example, so we would recommend that by the lack of current material correlation, some of the properties are really not known. So, we would suggest you choose an upper and lower and upper bound and sample with a normal or uniform distribution between the bounce and push that through a statistical code rapper like RAVEN or Dakota. So, this is caused mainly by the lack of good quality material information currently available for these properties.

Q: For RC-4.1 work scope, does it involve any tests or effects of irradiation on buffer or IPYC properties?

We would prefer that the existing database from the AGR program at INL first be explored. There's a lot of data available on from AGR-1 right through five six seven already. So please work through that first before suggesting new experiments that will be performed outside of that. That was mostly the purpose of the call in 2018. So, in 2019 existing data sets to be evaluated first, models to be set up instead of the focus on experimental work. So we want to make that clear the difference this here is more on the modeling and simulation side than the experimental side.

RC-10: Advanced Small Modular Reactor R&D

Q: Since the main topic (RC-10) is identified as pertaining to Advanced SMRs, does that preclude light-water designs as the research subject?

A: We consider emerging light water cooled SMR designs such as the NuScale SMR to be an “advanced design”. The intent of the SMR work scope statements were to be technology neutral, so working with a light water designer would not be considered as a negative factor. However, applicability of the proposed technology to many different design types (e.g., water, liquid metal, molten salt, gas) would be considered favorably in the review of the proposal.

Q: What would be your suggestions on how universities collaborate with existing SMR designs from industry?

A: I am aware that several of the organizations have research and development organizations within their structure, NuScale, for example, has outreach programs for universities. I'm sure the contacting the headquarters of those groups directly or the designers directly whoever they are. There's probably someone there you can talk to and it would it would make a lot of sense to try that.

Q: Are the market and economic analyses focused on the US or global?

A: I think the answer is either, as long as we're looking at ways to improve the marketability and eventual sale of the domestic product, you know, either domestically or internationally. I think that either is acceptable. And maybe that's a note that we need to take to update the scope.

Q: Do you know how many proposals might be funded in this area?

A: I do not. I would say that we probably have the ability to fund 1-2 each in the market and economic areas. I couldn't say on the capability development because that may be a higher dollar value.

Q: Would you be interested in scientific measurements of thermal expansions of ceramic linings for heat exchangers?

A: Yes.

Q: Does this scope support new SMR conceptual designs?

A: I can't say that it does but I think if that person were to do the research internally... I think if the at a component level if someone were to propose to do ceramic lined heat exchangers that that's a potential use for one of the existing vendors. So I think that you're in an area where you could make that proposal, it wouldn't hurt to talk to the vendors to see if they had any particular interest in this and if they did that would be helpful to the proposal or the application. I

Q: If it was an entirely new SMR conceptual design?

A: I don't think we're going to try to get into funding research on entirely new design is that's a pretty large chunk for a university right now.

Why don't we take that under consideration as potential scope to add next year?

Q: Would conducting a comprehensive life cycle analysis of SMRs that will consider new generations of construction materials for reducing maintenance costs and accelerated construction methods be of interest in the economic analysis area?

A: I think so, in the right context.