FY 2019 CINR FOA Workscope Specific Q&A

CINR Overview

My collaborators and I are working on the pre-application for the NEUP CINR call. We are aware that in past years for the NEUP calls, it was not allowed to identify anyone in the proposing team or their institutions in the narrative text. Based on my read through of this FOA, I do not see this restriction anymore. Can you please clarify whether we are allowed to identify ourselves in the narrative of the pre-application and application (if requested).

Yes, as of the 2019 CINR FOA applications you can identify yourselves, as they are no longer blind.

Is there a deadline set for pre-proposals?

The deadline will be set once the FOA is released. The deadline is typically 5 weeks from the release of the FOA.

Can individuals and institutions be identified in the technical narrative?

Absolutely.

Can we volunteer to be a reviewer for workscope topics that we are NOT submitting to?

Yes, there are basic criteria to follow and you need to register with our site, provide a full CV and some other metadata and then we would be happy to use you as a reviewer as long as there is no conflict of interest. We would encourage faculty and national lab folks to submit to be an approved reviewer. The more reviewers we have the better the process is. Young faculty in particular, you can put this on your resume that you served DOE HQ with the whole process.

Since you will not do a semi-blind review, what is the review process?

The review process is the same, it just doesn't have the semi-blind component. Mechanically as it unfolds, we would allow the reviewer access to your technical narrative which used to be blinded; they would enter their review score and comments on that and then those were locked down so they were unable to update that later. Reviewers then move on to evaluate all the other materials in the application. Reviewers will have all those materials available to them for all sections of the review.

Can research scientists from Universities be the lead PI?

Yes they can, if approved by their own university.

Are National Laboratory Joint appointees allowed to submit as a university PI?

As a joint appointee you can submit as a national lab or a university PI, but not both as leading collaborator. You can't have an application in one area as a university PI and an application in another areas as the national lab PI. Also if you are a lead university PI, you have to be a university Co-PI across the board as well.

Do reactor upgrades and GSI projects considered in the CINR R&D project limit?

No, nor would a no-cost extension on one of those projects count in the project limit of CINR.

For R&D applications, in the case that pre-proposals were not invited but still eligible to submit full applications, will they go to the same reviewers or new reviewers for technical review? Also will the PI be able to respond to the first technical review in the final application?

It is likely a proposal will go through the same reviewers for full proposal review as in pre-proposal review, but not guaranteed. The PI will have a chance to respond to the technical review on the pre-application before developing the full application, by considering the remarks provided and taking heed when developing the full application.

I have an ongoing NEUP project. Can I still lead 3 pre-applications? But understand I can only lead 2 new full applications?

That is correct.

For the IRP that requires a Japanese partner, could the Japanese partner be funded? Or they have to find their funding from Japan?

They have to have their own funding from Japan. There are no US funds that are sent to a foreign institution.

For including a list of publications resulting from prior CINR funding, do we have a separate designated area for this information, or does it go into our 10 page technical write up or biosketch?

No it's not part of your 10-pages, you'll have a separate document upload for that information. It can take whatever form or format you'd like it to, but demographically it does not count towards your 10-page limit. On the application site, it will have its own upload area.

For industry FOA lead projects, do these count against other DOE CINR projects allowed, or do those projects count against applying for these applications?

No, Industry FOA lead projects don't count against the number of other CINR projects you can lead, these are two different entities.

I'm an affiliate faculty at university and owner of a private company (member of the Nuclear Industry Council and former SBIR awardee). May I apply to be a PI in the university-led programs and have my company as a partner?

This does have repercussions of conflict of interest and may not be allowed. Without all the information of the particular circumstance, it's hard to determine. If there is a very unique capability from the company and there is not benefit to the owner, it is something that could potentially be allowed. That is something that would have to be fully addressed. Usually a university will not allow someone that is not a full time employee to be a PI. It would be unlikely that someone from industry that is an adjunct professor be allowed to submit a proposal from the university. It does happen in the case of SBIR and STTR sometimes.

Is the involvement of national lab members recommended or a must?

Involvement of national lab partners is always recommended.

Are there detailed instructions on teaming with UK university partners?

The details we have are that your application should be developed so that it can have stand-alone success. We don't have a list of UK institutions and we will leave it up to you to make the connections. We will look at putting UK contact information on our website, if it's available. The NEUP.gov website hosts the NE Sourcebook which lists all faculty at universities and their talents. It can be sent to colleagues in the UK. They are trying to build up their nuclear program. It will be up to you to develop those contacts. In the past the UK has sent out instructions for their researchers, so if those become available, we will post those on NEUP.gov.

Are there any nationality restrictions to lead an NEUP project?

Yes, you must be employed full time by an US institution.

Scholarship & Fellowship Overview

In addition to GPA, what are the other consideration criteria?

Students must be affiliated with an IUP approved institution, and be a US Citizen or legal permanent resident of the US. Students must have completed at least one semester of undergraduate study to apply and be enrolled as an undergraduate at the time of award. Students must have maintained at least a 3.25 cumulative GPA (on 4.0 scale) for scholarships, and 3.5 cumulative GPA for fellowships, and GPAs are not rounded. Students holding an F1 visa

are not eligible. Generally for fellowships, applicants are eligible to apply during their senior year of undergraduate studies, after graduating from an undergraduate college and prior to entering graduate school, or during their first or second year of graduate study. This is listed in the FOAs. We will be asking for letters of reference, transcripts, and for fellowships a career statement and small essay.

How do I find out if my university is an IUP university?

There is a full list of those 83 universities in the solicitation.

Can health physics students be funded?

Yes they can be funded.

Why such a high UG GPA requirement for graduate level fellowships?

The graduate level requirement of 3.5 or higher is reasonable for fellowships. Our basic awardee is much higher than that on their GPA, so that is where we have adjusted it so we have the appropriate number of applications to review without receiving too many that would not be successful, even if they had everything else correct. The scholarship GPA requirement is lower than the fellowship GPA requirement.

Can a mechanical engineering student with a minor in nuclear engineering be eligible for application for both scholarship and fellowship programs?

Yes; you don't have to major in nuclear engineering.

Where can I find the solicitation?

At www.neup.gov and it will be released in August, 2018. It is not released yet, as of this distribution.

University GPAs have become inflated at most universities. Why is your threshold so high? As a professor monitoring this I have found that recommendations and productivity are better metrics.

It's not really a focus on the GPA, it's just an entry number to allow submission. We also take letters of reference that have just as much or more weight. It's just a question of being eligible to submit. GPA does not determine outcome, it only determines eligibility.

What obligations do the recipients of the scholarships/fellowships have after they graduate?

None. At the fellowship level, we will track what our applicants are doing following graduation, so there will be some contact about once per year for five years. There is no employment requirement or further responsibilities working with the department.

Does the area of study need to be nuclear energy generation, or can it be related to nuclear energy such as plant operations?

It can certainly be on plant operations. This is nuclear science and education, so when you think in terms of that it's not just the generation of energy, it has everything to do with the holistic field.

Do minority student applicants have special treatment?

No, and that is not something that we can ask for on an application form. This is strictly merit based.

Can you clarify the distinctions between areas of energy, environment, national security in relation to nuclear forensics and environmental management? Two areas that you have indicated are not a priority.

For this RPA, focus areas of nuclear forensics and environmental management are not attractive to DOE-NE. IUP as a whole is a composite program provides funding to the NRC and the NNSA which have different interest areas and you may be eligible for one of their awards. They are entirely different solicitations.

Can part of the scholarship funds be used for travel/equipment?

The RFA contains detailed information for the scholarship program, and no travel funds are provided. For fellowship there is some travel allocation in the award. Be sure to check the RFAs.

Is there a limit on having other scholarships and fellowships at the same time?

Yes. If you are looking at federal support through other institutions so that you might be double dipping, per se, that is not allowed. If you are a military applicant, there are specific guidelines in how you can be funded, and if you choose to take summer employment there will be a reduction in your stipend. As a fellowship awardee we anticipate you will pursue and conclude an internship at a national lab or other DOE approved facility. During those opportunities you will be ineligible for payment because you will be on salary by IUP.

Other additional support from an industry representatives like EPRI (research grant project) would need to be looked at to make sure it would not be a distraction or inappropriately make you lose focus on what you are being supported to do through IUP. More details are in the request for applications.

NSUF Overview (including NSUF-2 scopes)

Does the library contain results of prior examinations?

Yes, we do have connected to the library all the information we have available on the material which would include information on pedigree, pre-irradiation characterization as well as radiation history of the material and connections to results on prior projects.

Are the two synchrotron irradiation beamlines having difficulty handling radioactive materials?

We are having some challenges handling radioactive materials at the advanced photon source at the MRKAT. We have been making progress, but have not resolved it to everyone's satisfaction. Obviously those facilities are a little bit different than a hot cell facility at that lab, so there can be some challenges dealing not only with levels but also potential contamination. Each proposal in that area will have to work through those challenges carefully to make sure we understand the challenges they have, and make sure they are acceptable to the facility.

Is there a connection or separation between the scope proposed in NSUF-2 proposals and GAIN or Industry FOA proposals?

We will research this topic and follow up with an answer by email.

I need to do neutron CT on heat exchanger. Can NSUF accept handling that material due to the irradiation? We develop sample environments for material testing.

This probably does not fall into NSUF focus on irradiation effects on fuels and materials. If the person with this question would like to contact Dan Ogden or Rory Kennedy; they can discuss further.

Can I assume that ion irradiations (as opposed to neutron irradiations) still "count" as irradiations?

Yes, irradiations can be gamma, ion, or neutron irradiations.

If I have already neutron irradiated materials in storage in my hot cells, I assume I can submit proposals using these materials (i.e., using materials that are not in the NSUF library)?

Yes, that's true. We always encourage those types of opportunities. We do consider that favorably in the process.

Is it possible to get access to your library of irradiated samples of structural alloys before submitting a proposal in order to obtain preliminary alloy design data?

We may already have some of that information, so please look in the library to see if there's a material of interest for characterization of pre-irradiated material information already available. If we don't have what you need, we may be able to get it for you.

Is a list of the facilities on slide 4 available online?

Yes, if you are interested in capabilities, please visit the NSUF website and feel free to contact the technical leads identified there for further discussion of detailed capability, availability, and technical details.

Infrastructure FOA Overview

Has NSUF recently published infrastructure capabilities that the nuclear community needs?

You can find all of these capabilities on our infrastructure website. You can go to www.nsuf.inl.gov and view our infrastructure resources under the "Resources" tab. This is for multiple facilities and institutions.

RC-1: Innovative New Nickel Alloys for Molten Salt Reactor Structural Applications

RC-1 - The solicitation explicitly encourages collaboration with researchers in the UK. Recently some concerns were brought up, since a lot of the MSR technology is licensed in the US, and there is a lot of interest in commercialization.

I would imagine that work funded by the DOE NEUP Program would be public domain but you can either see if the info is given in the FOA or you can enquire about it with the NEUP Office.

RC-1- I was wondering though how much a UK collaboration would actually be valuable for a review of the pre-proposal?

I don't have much information about the UK program except that they would consider applications from UK universities in the RC-1 area. My understanding is that the two proposals will be reviewed independently, although the possibility of additional R&D work funded by UK on the same topic and can be leveraged to benefit the US program would be of interest to the NEUP program.

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

RC-3 - Should the supporting workscope have ongoing flexible liquid metal component testing capabilities including molten salts?

No, this particular call is primarily looking at either lead or sodium coolants. Other MSRs are outside the scope.

RC-3 - Are heat exchangers for MSRs of interest too?

If the applicant can make the case for how the heat exchanger work would be applicable to lead or sodium coolants, that could be considered.

RC-3 - Can we develop sample environments for material testing?

Yes. That would be within the scope, if it could be shown how it would support particular technologies.

RC-3 - You mentioned partnering with UK entities - what was the name of that organization again? Can you provide more details on this?

The Engineering and Physical Sciences Research Council. They will be participating in the five workscopes mentioned in the overview and by the program managers. Currently there are no specifics on what the UK response will be, yet if applicants have UK contacts, this is an opportunity that will be presented in this workscope and several others. The PIs from the UK have also been invited to view this webinar. However, NEUP can't be a matchmaker for collaborations.

RC-3 - How does this scope differ from the one proposed for IRP-NEAMS-1?

This workscope will be released in the final FOA. It is believed it is more computationally focused to support the experimental program. For specific questions regarding this, email the POCs or NEUP staff.

RC-3 - What is desired/expected scale of micro-channel heat exchangers to be analyzed/tested?

Email the POCs can get PIs in touch with the right technical leads to see what scale is desired.

RC-3 - Can you provide more details about your expectation for sensor R&D?
The written workscope gives more detail, and specifies opaque management and prognostics. This is not meant to overlap with other, more general, scopes. There's work that's been done under sodium fueling and other sensors, such as thermal acoustic sensors, which is what is being looked at, specifically within the scope of the fast reactor program. For more follow up information email the POCs.

RC-3 - Is there coordination with a parallel UK "FOA"? Or, shall potential PIs need to search an index of funded UK researchers?

In the past, there have been parallel UK funding solicitation. At the time of the webinar, it was not yet available. Yes, PIs should contact UK researchers based on past methods. NEUP does not provide matchmaking.

RC-3 - Where can we find this list made by the Fast Reactor Working Group on their needs?

In the presentation there is a general listing of areas that have already been stated. Tom would have to talk with the industry workgroup about making that information publically available in terms of all the details. The areas that were relevant to the scope had detailed language provided.

RC-3 - Are you still interested in the fission products in liquid metals? Last year, there is specific call on this topic.

There is currently ongoing work on this, so it isn't generally within this particular scope. The desire is more for technology development or enhancement of analysis techniques for either safety analysis or core performance, whereas that is a more related mechanistic source term, and that is work more in the regulatory item of previous years, so not at this particular time.

RC-3 - Can you elaborate on uncertainty propagation analysis techniques?

It is generally broadly open, it would be worth looking at some of the work that has been done already within the fast reactor program. The focus is on either looking at improving safety analysis techniques and reducing uncertainty propagation or core performance in terms of items such as burn up or core design. The applicant should show how that correlates to potential cost savings or safety enhancements that may reduce operating costs or capital costs.

RC-3 - Are heat exchangers required to be micro-channel or can they be larger channel, but still more compact than conventional shell and tube heat exchangers? The desire is to mitigate microtube heat exchangers high delta T and poor transient behavior for load following and to reduce clogging potential of micro-channels?

That can be open, the webinar simply presented examples. The key is to correlate it with either a commercial design or a design that may be near-term deployment or how that technology could optimize heat exchanger development to support near-term deployment.

RC-3 - Do you have any understanding, at this point, about how many cooperative agreements will be recommended for funding in this workscope?

At the time of the webinar there wasn't a finalized budget. That means that questions about how many awards will be funded in each area was unknown to the program managers and the NEUP staff.

RC-5 & RC-6 (High Temperature Gas Reactors and Fluoride Salt-Cooled High Temperature Reactors)

RC-6.2 - Is there an FHR reference design identified?

There are several designs you can look at, there is no one specific design you have to use. There are industry designs and ORNL has a design, and there's a point design also made by ORNL. You can look at all those designs and see the details.

RC-6.2 - Is a heat pipe version of DRACS being considered that has specific on/off temperatures?

The heat pipe might be useful under 6.1 as a decay removal to keep the fuel cool. It is harder to imagine the heat pipe system for 6.2, but someone could propose a technique to sink the decay heat into the ground. The challenge is taking it from the reactor vessel and sinking it into the environment. We are asking for your best thoughts. If you think you can most effectively sink the amount of heat necessary for an FHR into the environment, we are interested.

RC-6 - FHR: Are proposals for developing new technology for DRACS (for example new Heat exchanger concepts) are also considered?

We'll have to see the details in the proposal, if they are reasonable, they will be considered.

Is it acceptable if a proposal only focuses on tritium removal mechanisms?

This would not be suggested, rather it should be a part of the 6.2 scope, but not the only scope.

RC-7 (Molten Salt Reactor Technologies)

RC-7 - Is the shutoff valve a generalized term for freeze seals for allowing dumping of the core with loss of cooling or high temperatures.

That is not a generalized term, those are two separate issues. If that is elected as the mechanism for the valve, freezing could be employed. Generally speaking a shut-off valve would be something that would operate reasonably rapidly, think of a containment isolation valve in an LWR; one of its properties is a rapid shutoff. A freeze valve would have to be redesigned to make it operate rapidly.

If so, could this be used to develop other types methods other than valves for salt dumping control mechanisms?

This isn't necessarily salt dumping, it is a containment isolation valve, intended to be on anything that is penetrating the containment boundary. It is presumed that most valves would be some sort of mechanical system. The question appears to be directed toward a dumping of salt, via a plug valve, verses what is being asked here, which is a mechanically operated valve.

RC-7 - Can alternatives to freeze valves *(or other valves)* that are NOT actually valves be covered under this funding?

No. This is a call specifically for valves for molten salt.

RC-7 - For the stainless steel 316 tests, what types of molten salt are you looking for, chloride or flouride?

Either. However, as demonstrated by the industry support shown on slide two or three, there are industries currently looking more into chloride for fast reactors. Proposals for either would be accepted.

RC-7 - Is there any specific apparatus for testing the corrosion of stainless steel?

There are combined tests – maybe doing some fatigue testing, may be a direct erosion test (which tends to be a nozzle type structure), there's direct metallography. There's not a single specific test, because, much like any other material, if looking at the combined impact of the service environment are all its performance properties.

RC-7 - Is the mechanical filter designed for chorine or fluorine salts?

Many other industry outreaches now are focused on chlorine, but proposals will be accepted for either. Fluoride will have more suspended things because it's got solubility limits. Filtering is a general request for MSRs.

RC-7 - How do you envision max flow for 7.2; pumps are expensive, is natural convection more realistic?

Pumps are expensive, and they are also difficult to obtain. In the testing of this, an applicant may try to do something which involves pressure differential drive. Certainly, very good flow velocity can be achieved for temporary testing using a differential pressure that just requires a gas phase control. However, trying to achieve high velocities, which was the concern in erosion, won't be attained with natural circulation.

RC-7 - For irradiation damage in molten salts, do you have to use neutron irradiation?

It's best to be as representative as possible, but it is recognized that there are financial limits. Certainly a huge irradiation campaign is beyond the scope of what's available financially. There is variation in this because it is hoped that there will be good ideas. To think that there will be an impact of cost due to radiation, is not a very realistic goal. The concept is: what can be brought forward, what are the proposals, what are the experiments and conditions.

RC-7 - Would ceramic coating of stainless steel be an option as a treatment to enhance the chemical durability?

Any options would be considered. Whether or not it is the best or only option is the issue. The call isn't narrowed down to say what technique or type would be the most viable way of doing business. Applicants are encouraged to submit ideas, which will be reviewed with all the other proposals.

RC-7 - Are you interested in creep and creep fatigue of 316SS at high temperatures without molten salt?

There is a wide database of information on creep and creep fatigue of 316 stainless steel without molten salt environments. Surrogates, or other conditions, can always be used, but the applicant is encouraged to be much more specific in an environment that supports 316 with molten salt. This is an alloy that is already in the high-temperature portion of the section three division five, so there are already established design limits. Admittedly, the data is for H and the call is looking for the general 316, which tends to overlap into H and L. Yet, the call is looking for what happens now – when it is wanted to be used in a molten salt service condition.

RC-7 - For 316L, is the corrosion and stress effect only limited to erosion type degradation?

No, it is the full set of things that would be happen in service. 316 will be stressed; it will have neutrons; it will have salt exposure; it will have thermal cycle. The call is trying to set some

realistic, experience-based limits on how the lifetime estimations for 316 change when it is put into an MSR service condition. The question specifically asks about 316L, but it would be looked at with a whole host of other things and not split into one area verses another.

RC-7 - Is only 316SS of interest, or would 304SS or other qualified stainless steels also be of interest?

316 was chosen, because it seems to be the most viable option for industry and commercial support. There is some discussion for 304, since it is closely related to 316. Proposals for 304 can be submitted.

Is UK partner not encouraged for this 7-2?

Please refer to the FOA for UK partner eligible workscopes through the EPSRC.

RC-8-10 (Light Water Reactor Sustainability Scope Areas)

Is there a limit to the number of proposals that can be submitted?

In past FOAs you can find this information since this one won't be released until later in August. A university PI can submit six pre-applications total, three proposals as the lead PI and three more as a Co-PI.

RC-8.2 - What specific conditions are you looking to monitor?

We are looking at all aspects of operations including power during shutdown conditions, getting process information, structural information, all feeding into what would support operations and maintenance activities.

RC-9.1 - According to last year (FY18) NEUP awards, there was one project analyzing coping time and cost analysis of accident tolerant plant design based on probabilistic risk assessment. Are you looking for a different aspect from RC.9-1?

Yes. We are looking to emphasize the combined strategies you may have for looking at the fuels and systems components, the combination analysis of fuels and accident tolerant fuels are included in combination with other advanced strategies. Application of multi-physics tools that both address deterministic and probabilistic areas combined and integrated for the benefit of the plants.

RC-9 - Will DOE provide access to deterioration and maintenance data, or it is the responsibility of the PIs to collect such data?

The intention is for the PIs to provide a data set or data bank that they would like to work on, or to partner with industry to acquire that data.

RC-9 - Is extreme natural event of interest in optimal maintenance planning?

Yes. Extreme events as being part of the activities being considered, particularly with respect to characterization.

RC-9.2 - Maintenance optimization focused solely on capitol refurbishment / replacement, or is there also interest in optimizing routine maintenance activities?

Three topics are of interest here: capitol refurbishment, existing components and maintenance and optimization, and also looking at the lifetime of components throughout long term operation.

RC-10.1 - Is ASR still considered?
Yes, we are very interested. Proposals don't have to be limited to either radiation damage effects or ASR, either subject is very valuable and relevant to work ongoing in the program.

RC-10.1 - Is modeling of multi-ion diffusion to predict initiation and progression of reinforcement corrosion in full coupling with crack initiating mechanisms (like ASR and freeze thaw) considered as important?

It is an important issue and could be applicable to this workscope.

RC-10.1 - Would coupling between ASR and irradiation effects modeling without specific testing considered appropriate for RC-10.1?

Yes, it could be of interest. There is some indication, though not really well established, that there may be some interactions radiation damage and ASR, or ASR further influenced by radiation damage.

RC-10.1 - Is reinforcing steel considered a concrete constituent of interest for this workscope? Or just the cementitious materials and aggregates?

Cement is a little more important right how. Within the program we have some work with the NRC on the rebar subject. We are more interested in the concrete makeup.

Would DOE provide access to irradiated concrete, or would proposers be responsible for sourcing this material?

We would be open to giving you access to irradiated concrete. You could work with DOE people that have access to irradiated concrete as an option.

RC-10.2 - Include validation of modelling by actual welding of irradiated materials? Is the emphasis on an advanced reactor or LWR?

It would be ideal to have an experimental component of at least some level to validate model predication, yes.

Will the application process require submission of white papers this year or it will go directly to full proposal?

The intention is to move back to the normal NEUP process which has a pre-application component that is typically due 6-8 weeks after release of the FOA. Also there is a full application component that will have invited and uninvited applications based on the results of the pre-application process.

NEET-1 & NSUF-1.2 (Advanced Methods for Manufacturing)

NSUF 1.2 - Does irradiation testing include PIE?

Yes.

Is additive manufacturing of concrete containment structures considered?

No, not this year.

Is additive manufacturing of novel materials of interest?

If it falls under factory and fuel fabrication.

Are you interested in in-situ quality control or quality controlled technologies for fabricated AM parts?

Yes, we are interested in quality control.

It appears you may have some target welding methods in mind, and if so, what speeds and target configurations might be in mind? (e.g. pipes)

We don't have that level of specificity in mind at this point. We are open to new welding techniques to improve the speed and quality, in general, in new joining technologies.

Is the design and fabrication of electromagnetic pumps for liquid metal reactors using advanced manufacturing techniques like hybrid, traditional, and metal additive manufacturing included?

Our goal is to reduce the time to construct and reduce the cost and to improve the reliability of components. If you look at previous work it's relatively near term. We would suggest you consider your application in that context.

Is the interest more focused on cheaper materials or advanced materials? Sometimes advanced materials are very expensive.

The interest is in both. It would be a benefit to have both together. Ultimately, whatever is done needs to have some commercial viability.

Can you clarify what is meant by factory and fuel fabrication?

In general we mean overall improvements in shop floor applications, surface modification techniques, routing techniques, and joining technologies.

How many projects are expected to be funded in the AMM scope?

DOE does not have a final budget for FY19, so there is no accurate projection of an expected number of awards that can be given by the program managers.

Does the interest focus towards manufacturing specifically or materials development?

It is both manufacturing and materials development though this is not a materials program. The program is advanced methods for manufacturing.

Could concepts focused on in-process monitoring for quality control purposes be of interest?

Yes

Is there high interest on AM techniques that have not been explored to date?

That is a broad question, but if it fits in the context of the conversation we have had and the FOA and other work that has been done, it might be.

FC-1.3

I had a question about the TPT process off-gas stream mentioned in FC-1.3B. Is this treated separately from the shear and dissolver off-gas? I've read documents that indicate that the shear gas gets combined with the dissolver off-gas, so I was wondering if this was also the case with the TPT process off-gas stream.

There are a few concepts being discussed, but the common thread is that particulate Iodine, and Tritium get removed locally at the pretreatment process with recycle of NOX. Once the

gasses leave that operation, they may be combined in different ways with shear and or DOG. However, we aren't currently considering a flowsheet where DOG and/or Shear off-gas would be funneled through the TPT process gas stream before Iodine and Tritium removal.

Are MOF related proposals acceptable?

Yes, MOF related proposals would absolutely be accepted.

Is the program interested in fundamental research such as structural and chemical properties which control iodine sorption in MOFs?

This is a very applied program. The target should be to generate a working solution to a practical problem in 3 years or less. If science is needed to generate and demonstrate that solution, it's acceptable but the main target should not be fundamental science.

Are cements and geopolymers applicable?

Cements and geopolymers have not (to the best of my knowledge) been successfully applied to HLW. The primary issues have been: 1) large volumes, 2) poor durability, 3) effects of radiolysis (e.g., H2 gas generation, etc.). That being said. There may be ways to manage those issues.

Will there be actinides in the HLW waste stream discussed in the the report "Closed Fuel Cycle Waste Treatment Strategy"?

While actinides are present in Table 1.5 where the composition of HLW has been discussed, it has been later stated in the report that the current flowsheet processes include removal of most actinide species from the waste stream.

What about iodine and Tc? According to 2015 report, these ions exist in HLW. However, they are not considered in any waste form discussed in that report. Will they be removed before the immobilization of this waste stream?

All of the Tc will be in HLW, most of the I will not, but some will.

What media are the waste forms to be researched expected to come out of, aqueous nitric acid solutions from traditional reprocessing concepts or molten salt streams from advanced reactor/reprocessing concepts?

We are considering aqueous reprocessing raffinate. There are a number of estimates for that flavor of waste. One such estimate is in: J.D. Vienna, et al. 2015. *Closed Fuel Cycle Waste Treatment Strategy*, FCRD-MRWFD-2015-000674, PNNL-24114.

What waste stream the scope is looking for?

That would be high level waste raffinate from aqueous reprocessing of commercial spent nuclear fuel. Probably the best example is in the report: Vienna, J.D., et al. 2015. *Closed Fuel Cycle Waste Treatment Strategy*, FCRD-MRWFD-2015-000674, PNNL-24114, Pacific Northwest National Laboratory, Richland, WA.

Will the melting of multicomponent ceramics be considered?

It wouldn't be ruled out, but, primarily we are looking for low-cost process options. In my mind, that would be compared to the baseline of vitrification. The melt process ceramics are likely to be similar cost and higher complexity than vitrification. But, you may have an enhancement on that type of process that reduce cost and complexity.

Could you please point out to a published source on waste streams and chemistry that are of CURRENT INTEREST for multiphase ceramic waste form mentioned in the call?

The waste stream described in table 1.5 are of interest in the following report: Vienna, J.D., et al. 2015. *Closed Fuel Cycle Waste Treatment Strategy*, FCRD-MRWFD-2015-000674, PNNL-24114, Pacific Northwest National Laboratory, Richland, WA. One of the right two columns for elemental components. It will also have relatively high nitric acid solution (~5M). These wastes are constantly changing, but, this is a good starting point.

In the past, PNNL worked on glass-ceramic composite waste forms for high waste loading, particularly Mo. Are Mo or a wide range of waste stream the major interests of this workscope?

That would be high level waste raffinate from aqueous reprocessing of commercial spent nuclear fuel. Probably the best example is in the report: Vienna, J.D., et al. 2015. *Closed Fuel Cycle Waste Treatment Strategy*, FCRD-MRWFD-2015-000674, PNNL-24114, Pacific Northwest National Laboratory, Richland, WA.

For the low-cost processing methods that are applicable to high radiation field, will the melting of multicomponent ceramics developed by SNL the lead technique to be considered?

A range of compositions would be of interest, but those close to the ones that SNL has been working on.

Will the melting of multicomponent ceramics be considered?

It wouldn't be ruled out, but, primarily we are looking for low-cost process options. In my mind, that would be compared to the baseline of vitrification. The melt process ceramics are likely to be similar cost and higher complexity than vitrification. But, you may have an enhancement on that type of process that reduce cost and complexity.

A colleague of mine in the MSE program has been doing some very interesting work on the mechanisms for hydration and crystallization of cements. He is interested in applying his thermodynamic and kinetic models for the design of non-thermal ceramic wasteforms (geopolymeric and hydroceramic) for HLW, and has talked to me about whether or not to take a run at the FY19 CINR call on Advanced Waste Form Design. His work is really nice, basic materials science, not just because he starts with either melt-derived aluminosilicate glasses or with commercial fly ash aluminosilicates. What we don't know, however, is if your workscope covers materials like these. Any advice you care to pass along would be greatly appreciated.

Cements and geopolymers have not (to the best of my knowledge) been successfully applied to HLW. The primary issues have been: 1) large volumes, 2) poor durability, 3) effects of radiolysis (e.g., H2 gas generation, etc.). That being said, there may be ways to manage those issues. For example, a specific PI made a convincing argument that a better approach to HLW management is to generate a very large volume of HLW cement and dispose on site at/under the reprocessing plant. If the volume is large enough, the performance issues and radiolysis issues would be minimized.

FC-4 and IRP-FC-1 (Used Fuel Disposition)

Could you please elaborate on the novel buffer material concept?

We do welcome proposals that would provide alternatives to the standard buffer material used in design concepts. Most repositories use a bentonite buffer packed around the package to provide a low permeable barrier and a reactive sorption barrier. If there are proposals that offer an alternative way to improve sorption capacity and implaceability, we would be interested in those topics.

Can an R&D proposal focus on both engineered barrier degradation and nuclide transport or it is better to pick one?

The PI could choose themselves. There would be no penalty for addressing multiple topics, just a question of the technical merits of the proposal and how well integrated it was and was is a manageable scope of work.

In deep disposal, is it expected to have concrete overpacks too?

A proposal that addresses concrete overpacks should at least address the question of what disposal concepts might use concrete overpacks. Obviously there are some in the world that do

use them. The US is not locked into any one disposal concept. However, barrier concepts that don't map to some viable disposal concept will not fare as well. Make sure you show the link.

Should proposals include a "treatment of reasonable assurance" for the modeling?

We are interested in things that can and will be deployed by industry. They would be looking at the regulatory aspects of what is proposed, so this would be applicable.

FC-4.1 - Is modeling of the nuclide transport more important or Canister corrosion more of an interest?

Both are important and are of equal weight.

FC-4.1 - Is the nuclear waste form being considered both glass and hard ceramic or just one of either.

Both are being considered as well as uranium oxide fuel.
Are models for fission product gas transport from a geological repository of interest under FC-4.1?

4.1 looks at the chemistry of what's happening in the zone of the engineered barrier and the unsaturated zone. Yes, this would be of interested.

FC-4.2 - Is this mainly a modeling effort? Do you prefer physics based model or experimental data driven model? If it is a modeling effort, how does the repair fit into this scope?

It depends on the technical merits of individual proposals. We prefer strong proposals for work that can be adopted and deployed by industry.

FC- 4.2 - Is there an interest in either in-cask or ex-cask sensor development for model validation?

If it's in the context of something that directly addresses something in the call, then it would be of interest. If it was a stand-alone proposal, then it would probably not be of interest.

The FC-4.2 scope of work appears to be similar to the last year one. This year on the presentation page posted on the website is more general.

There was not an intention for the information to be different. If this is addressing the IRP, the final FOA will have a complete description. Information posted on the NEUP webpage at this time includes only draft workscopes, so watch for the final wording in the FOA final release to make sure you have the correct information.

During a previous slide for FC-4 in-package monitoring was listed, but your final slide did not discuss this. Are proposals for in-package monitoring systems of interest?

They are of interest if they are unique. We are trying to emphasize other items in this call. Watch for the final details in the call and be sure to follow them closely.

Is there an interest for studying novel material for transportation cask as R&D proposal?

Not in this call.

FC-5: Fabrication Process Assessments for Cost Algorithm

Is the emphasis on advanced reactors or LWRs?

It is on both and we would expect the algorithms to be generic enough to be used for both. The starting point should be on LWRs.

FC-6: Interface Tools for Transmutation Data Library

No questions

MS-RC-1: Special Purpose Reactors R&D

Will novel techniques to improve the part quality during additive manufacturing be of interest?

Yes, if they are specific to microreactor concepts as opposed to broad general advanced manufacturing.

MS-FC-1: Maintaining and Building Upon the Halden Legacy (In-Situ Diagnostics)

Is Halden involved at this time?

Yes, in Idaho there was a conference to assess the loss of the Halden. The Halden managers were there with many national labs and many people in attendance. They were very open sharing their status, techniques and legacy.

On the INL website there's a draft report published from this meeting that lists all the facilities in the world that could replace Halden, and it discusses the technologies as well.

Are you interested in data processing as well?

Yes, but it would have a low emphasis. The challenge is putting things in the hostile reactor environment and getting data out. The focus is on getting the signal out of the reactor.

Is the final project deliverable expected to be a trade or feasibility study or some level of prototype development?

With the amount of funds given, we would expect physical work and some type of prototype development. If you are proposing something very complex, then perhaps it should just stay on paper and be feasible. Testable hardware would be the preferable product.

The idea for this workscope is to be creative and open for getting data out of the reactor. There are a lot of sensors out there that we cannot use inside a reactor.

Putting several diagnostics into one experiment would be a plus for a proposal in this area.

NEAMS-2, IRP-NEAMS-1 (Nuclear Energy Advanced Modeling and Simulation)

For the IRP, do you need experiments for code validation?

Please use existing experimental data as much as possible. Doing meaningful experiments and achieving all of the scope in a three or four year period would likely not be enough time. Mining data currently available would be suggested.

Is there NEAMS-1.1 this year?

No, there is the IRP-NEAMS-1, NEAMS-2, and MS-NE-2 that are NEAMS related scopes.

MS-NE-1: Integral Benchmark Evaluations

No questions asked.

MS-NE-2: Nuclear Data Needs for Nuclear Energy Applications

No questions asked.

RC-1: Innovative New Nickel Alloys for Molten Salt Reactor Structural Applications

Are new nickel alloys for MSR structural components of interest?

We are interested in any nickel alloys that could potentially meet the property attributes described in the RC-1 scope, particularly those that present a way forward for scaling up the fabrication process to support welded construction of structural components for advanced reactor applications. We highly encourage submittal of such proposals.

Are these three materials are of interest for the call:
1- Ni-based ODS alloys
2- Nanoporous high entropy alloys
3- Nickel-based superalloys with intermetallic particles?

We are interested in any nickel-based alloys that have the attributes described in the RC-1 scope. Any rationales that can be provided in the pre-proposal on the potential of the selected candidate materials to meet those attributes, and how the PI plans to demonstrate it in the proposed work, will be very helpful for reviewers.

Is developing a computation approach for high throughput numerical methods for simulation of microstructures of interest in RC-1?

RC-1 is an "experimental" task in that we want universities to make new or test existing alloys with the attributes that are described in the RC-1 scope. If ICME is part of an overall strategy to aid the selection of the alloys for experimentation, it would be great. But the emphasis of this call is not on computational method per se.

Do you have a HEA in mind or do you want us to propose the material?

The scope of RC-1 is on nickel alloys.

If we propose the material, will we be responsible with the processing of the material and the specimens?

Yes, the PI will be responsible.

Do you have a laboratory or contact you would suggest?

DOE-NE does not recommend partnerships. Those relationships must be made by the PI.

Can nickel alloys be combined with other materials?

As we have stated at the CINR webinar, we highly encourage universities to respond to this call with any innovative ideas to help us addressing this very challenging materials issue.

RC-1 - Is it required to discuss how nanostructured Ni-alloys fabrication would be scaled up from the lab scale to the industrial scale?

We stated in the scope that it would be good to have an idea of existing or new materials that could be scaled up in some fashion. The materials will need to be used in a structural application and will need to be used in a scaled up fashion.

Can we propose alloys other than nickel alloys?

The call is specific for nickel alloys only.

Should one single proposal address all the characteristics listed such as strength fuel salt compatibility, damage resistance, or can we focus on just one?

We would like to have as much information as we can get for each award given. If you address one specific aspect, you might miss any synergistic effects that could be happening. Some places may not have the capability to focus on multiple characteristics, but we would like to have several variables tested in one proposal.

Are you interested in new alloy proposals or only testing the current alloys?

We are interested in both. One of the struggles with a new alloy is the push, time and costs are much more lengthy and costly. We would also like more information on the alloys we have a firm handle on already. If there are existing alloys that will address the requirements for these applications, that would be great. If not we would be interested to get new ideas from the university community to address the issues under this extreme environment.

How can we use DOE data of experimentally evaluated irradiated alloys?

We are not aware of irradiated alloys in the recent past.

What kinds/scales of computational materials studies are encouraged in coordination with experimental studies?

Definitely integrated computational materials engineering is very important and has been shown to cut down on materials development time as well as helping to target high value experiments. We would like to hear new ideas from the university community. We encourage submission of these computational materials studies, but not sure about specific kinds.

What is your priority? New theories and design methodologies or actual chemistry and experimentally confirmed new alloys.

Ultimate goal is to have usable alloys.

Are you interested in alloy modification around the currently selected Hasteloy or other commercial alloys?

We know what the problems are; high temperature strength, corrosion, issues with salt, sulfur irradiation, etc. Anything that proposers can do to address those issues would be acceptible. If there's an existing alloy that we don't know of, that would be great to know. Modifications of the current alloys would also be accepted if they can address these issues.

Will surface modification of the alloys fall within the scope?

If the surface modification can address the outlined issues, then yes.

How can we initiate interactions or joint projects with UK universities?

We currently don't have any more information on the ESRPC/UK collaborations. In the past based on previous experience, the UK releases FOAs for their researchers. If you have researchers that you would like to collaborate with, we encourage you to contact them directly.

NE-1: Nuclear Energy-Cybersecurity Research Topics and Metrics Analyses

No questions asked.

NE-2: Hybrid Energy Systems Design and Modeling

Are there any requirements to include uncertainties in the optimization algorithms?

It is desirable to have uncertainties in anything associated with computational work, so that quality of the simulation relative to the actual can be understood using some sort of quantification of the uncertainties. It is not an absolute requirement, but it is preferred.

Could a university propose with an actual nuclear power plant?

Yes, universities can partner with nuclear power plants within the restraints of CINR call. For example, non-universities only receiving up to 20% of the funding.

Are there any CO2 related research focus areas?

Not specifically, but in optimizing these systems, reduction of emissions is part of the goal in looking at how hybrid energy systems or integrated energy systems are operated. However, this particular area under NE, there is not a focus on CO2 research. Utilization of CO2 in coupled applications could be a part of the research though.

Will INL provide the benchmark system for demonstrating the developed approach?

Lists of what has already been modeled, and what that configuration looks like when optimizations of integrated systems are run through, can be provided. If somebody is doing a research project, there is an option of getting participation in the development framework. Some of what has been worked on has already gone open source. Others are in development and not yet open source, but that framework can certainly be shared with individuals or universities that are doing development work on that same platform. It's a matter of getting approvals run through the system to access the codes. However, in advance of award, reports and lists of what components are available and the overall structure can be provided.

NEET 2, NEET 3 and NSUF-1.2: Advanced Sensors and Instrumentation

NEET 2.2 - Are you interested in sensors for advanced reactor such as MSRs?

Yes.

NEET 2.3 - Can funds be used for irradiation testing in material test reactors?

More information is needed to answer this question – please contact the POC.

Thermophysical and other properties can be accurately and quickly calculated using remotely placed sensors, temperature heat flux stress deformation, etc. Are you interested in proposals for developing fast computing algorithms for these remote measurements to predict such properties inside the reactor?

We would be interested in an application that could be integrated and added into some of the sensors currently being used.

Regarding this statement in NEET-2.1, rad-harden electronics for digital based components, Can you comment on the expected radiation levels or perhaps the location of interest for rad-harden electronics? Do locations include in-vessel electronics?

Yes. We are talking about mega-rad material for in-core measurements as well as electronics outside the vessel which would support PLC or microprocessing. The focus of this topic is on advanced reactors.

NEET-2.3 - Should we address all bullet points or just one of them?

You could address some of the bullets but it does not have to be all of them. Please contact the POCs if you would like to discuss more.

NSUF-1.2 - Does irradiation testing include PIE?

Yes.

Does radiation resistant instrumentation also require resistance to corrosives, for example molten salt, lead, or other environments?

Yes, if it's going to be for one of those types of applications.

In regard to rad-hardened electronics, are you looking for radiation resistant/identification algorithms?

More clarification would be needed before an answer can be provided. Please contact the POCs for further discussion.

RC-2: Salt Behavior in Molten Salt Reactors

In RC 2.1, are we discouraged to add experimental approaches as one task to help better understand, predict, and optimize the physical properties, structures, and dynamics of molten salt, in addition to pure modeling efforts?

Experimental and modeling approaches are encouraged for this topic.

Is experimentally measuring thermophysical properties of nuclear relevant molten salts in addition to MD-simulation modeling of interest to RC-2? If so, would RC-2.1 or RC-2.2 be a better fit?

For the RC-2.1 subtopic, our focus is to develop thermodynamic models to predict critical salt characteristics, such as the melting points, heat capacity, free energies for potential corrosion reactions, and solubility for fission and corrosion products as a function of temperature and composition. Under this subtopic, we seek to better understand, predict, and optimize the physical properties and thermochemical behavior of molten salts. Our goal for RC-2.1 is to develop and use first-principles molecular dynamics simulations and computational electronic

structure method to extend the limited experimental data sets in covering a broader range of chemical evolution and environments.

For the RC-2.2 subtopic, the focus is to understand how the structure and dynamics of molten salts impact their physical and chemical properties, such as viscosity, solubility, volatility, and thermal conductivity, to determine the speciation of salt components as well as the local and intermediate structure at operationally relevant temperatures. We seek to take advantage of recent breakthroughs in advanced characterization tools and instrumentation methods to provide information at the atomic and molecular scale. The goals are to determine the local structure and bonding of chemical species in salt solution and to develop innovative real-time analytical methods for microscopic and macroscopic property measurements to underpin and support molten salt reactor design and development.

To experimentally measure thermophysical properties of molten salts for developing predictive models and molecular dynamics simulations will be of interest to this call. The workscope depends on your overall research objective. If your main objective is to better understand, predict, and optimize the physical properties, structures, and dynamics of molten salt, you may want to consider RC-2.1. If your objective is to understand the structure and speciation of molten salt at atomic and molecular scale, please consider RC-2.2.

Would collaborative proposals of experiment and theory covering both RC 2.1 and 2.2 be encouraged?
No, you must choose one scope or the other. The same proposals cannot be submitted to two different workscopes.

In the second part, will the first principle modeling of thermoconductivity be considered?

In RC-2.1, yes it will.

I saw a bullet in the presentation on guiding next generation materials. Will alloy development fit in any of these topics?

Not this year.

It seems like these two topics are very similar to last year's call. Can you please explain the difference between the topics in the two years?

RC-2.1 has some changes this year, but RC-2.2 is very similar to last year.

Would collaborative proposals on experiment and theory covering RC 2.1 and 2.2 be encouraged?

Yes, but be sure to have the main focus of the main topic submitted to the correct workscope since you cannot submit the same proposal to both workscope areas. Main focuses on

modeling would be submitted to RC-2.1 and main focuses on experiments would be submitted to RC-2.2.

Have you thought about CO2 reactions within molten salts and would that fit within the topic?

That is not part of the call this year. We are looking for fundamental understanding of molten salts.

How many awards are expected to be funded in this workscope?

DOE does not have a final budget for FY19, so there is no accurate projection of an expected number of awards that can be given by the program managers.

In RC 2.2, are we discouraged to add modeling as one task to help understand the structure and speciation of molten salt at atomic and molecular scale, in addition to a full range of innovative techniques that we will propose to address those issues?

Experimental and modeling approaches are encouraged for this topic.

FC-1: Material Recovery and Waste Form Development

No questions.

FC-3: Advanced Data Integration for Domestic Nuclear Safeguards

How should responses to this call synergize with the award to Tennessee last year on the Materials Accountability for Toolbox for MSRs?

That work is just beginning and there could possibly be some overlap with a new proposal and that work. Please call the POCs to have a lengthier discussion on this potential. The potential conversations that may be held with lab POCs will be given out to all applicants.

Can we contact the lab POC to ask about the potential for recommending a potential lab collaborator?

Yes. Understand that the potential conversations that may be held with lab POCs will be given out to all applicants.

FC-2 (Advanced Fuels)

Who are the 3 ATF vendors referenced in this workscope presentation?

Framatome – prime concept is a coating on their zircaloy form
Westinghouse – considering both coatings on zircaloy and has a prime interest of silicon carbide related cladding, a composite of more than one item
General Electric – new iron chrome aluminum combination

FC 2.1 - Non Destructive Examination (NDE) Techniques, can you explain why the signal is difficult to be transmitted out?

The measurements need to occur in side the hot cell. The difficulty is that the signal needs to pass about 30 feet from the measurement device to a data collection computer. Then the signal needs to pass through a hermitically sealed feed-through. There are certain things that just won't work in that situation. For example, USB 3.0 is not amenable to being converted into an hermitically sealed feed-through and also typically won't work beyond 10 feet cable length.

FC-2.2 - How important is thermo-mechanical analysis of potential advanced components in LWR? Both modelling and experiment are preferable or one of them is acceptable?

You could not ignore such considerations if you are looking at new or new combinations of materials. Thermo-mechanics is very much related to this workscope. Doing both modeling and experimental work is acceptable; however just a paper idea would likely not have good success.

FC-2.4 – How much weight will be given to an industrial collaboration?

We like to see industrial collaboration because that shows there is a concept, but that's not the primary consideration. There is a potential 5 point bonus given to strategic partnerships that include minority serving institutions, under-represented groups, industry collaborations and international collaborations in the relevancy portion of the review.

FC-2.4: Multiscale models typically need to be tuned to a specific material. What specific materials are of interest for the accelerated creep testing project?

A few examples are given in the workscope and they include any alloy that has not been extensively studied before.

Does FC 2.5 require modeling/simulation as well as irradiation studies in the proposal?

Technically no, but it would be nice if you can identify the analytics the experiments would have. Regarding modeling and simulation, we are looking for the discovery of new physics and new phenomenon that can ultimately go into modeling and simulation. So it would be very satisfactory to do physical experimentation, measure phenomena, characterize them with

formulas and mathematics, never touching a computer. If you could identify ongoing DOE codes, this would help and get attention.

For the advanced creep testing, do you have a preference on the type of loading?

Yes, the preference is to have the loading in tension. There is no preference on strain versus over load control.

FC 2.5 - Do the materials need to be fissile or can they be surrogate systems?

It's open beyond fissile, you could have surrogates and non-fissile materials. We are looking at separate effects and fundamentals. We would give priority to direct materials that were used unless a real strong case was made that the surrogate is essential to develop some code. Keep in mind you are in ATR where there is nuclear exposure.

Could you please summarize again the procedures and dates for getting approval from NSUF prior to submitting a NEUP pre-application?

Two workscopes that are NSUF related in NEAMS 2 and FC-2.5 only for university applicant leads and they require NSUF access. There is a LOI required to be submitted (during a three-week time period) to the NEUP website to be considered further. After the LOI deadline and 3 weeks later pre-applications are required to be submitted.

IRP-NE-1: International Challenge Problem for Nuclear Energy

What are the deadlines for the IRP-NE-1 program both on the US side and, if possible, the Japanese side?

Thank you for your interest in IRP NE-1. For the United States, IRP applications are due on February 12, 2019. Please visit the following link for application deadlines as well as the most recent FOA language and additional resources: https://neup.inl.gov/Lists/Headlines/AnnouncementDispForm.aspx?ID=185. On the Japanese side, they plan to announce the call for applications in the January timeframe.

We expect U.S. university teams to reach out to Japan to engage potential Japanese university researchers. Once U.S. -Japanese teams have been established we would expect U.S. principal investigators would confirm that the Japanese researchers who they plan to collaborate with have applied for designated Japanese funding.

Please contact Shoji Kasuga at kokusai-genshiryoku@mext.go.jp for additional information on the Japanese program.

Does Japanese government have a say on the winner?

No.

How many U.S. universities are required to be part of the IRP?

At least one US university, but we recommend more than one.

Is JAEA participation required or mandatory?

It's not required, they are one of the potential collaborators.

Is the use of NSUF required?

No, this is not an area that is tied to NSUF. They can use the facilities, but it cannot be funded by the project in this workscope. If you are interested in a particular facility, you'd have to have the owner of that facility on your proposal team.

Can Japanese corporation participate?

Yes, a Japanese research corporation can participate, but we also require at least two Japanese universities to participate.

Are industrial partners on the US side encouraged?

Yes, they are encouraged.

Can a Japanese university be a partner on more than one proposal? If they have already partnered with different US university, can they still partner with my university?

Yes, they can collaborate on more than one proposal.

Is this project focused on research, workforce development, or both?

Both, by performing the research you develop the workforce.

Is the involvement of national lab partners required?

Though not usually a requirement for the CINR process, at least one US national lab partner is required for this IRP.

RC-4: HTGR TRISO Fuel Particle Materials

Are there any TRISO specimens available from the DOE Advanced Gas Reactor (AGR) TRISO fuels program for these CINR calls?

The Advanced Gas Reactor program possesses several types of specimens that may be of interest for the RC-4.1 and 4.2 work scopes. These include (1) surrogate TRISO particles with ZrO_2 kernels and (2) small specimens extracted from irradiated TRISO particle cross sections using a focused ion beam. These will be discussed in further detail below.
The surrogate TRISO particles are available in small quantities. These currently reside in a contaminated zone. While they were not prepared using any uranium-bearing materials, they may contain trace quantities of uranium contamination. Applicants will need to assess the feasibility of using these materials in their institutions' laboratories.
A number of archived irradiated TRISO particle cross sections are available from the AGR-1 and AGR-2 experiments at INL and ORNL, spanning a range of irradiation conditions (temperature, burnup, and fast neutron fluence). FIB specimens can be prepared from these cross sections for subsequent activities. These specimens may contain small amounts of certain fission products and actinides. Typically, the radiation dose from these specimens is below detection limit and they examined in non-shield instruments (for example, at the INL Center for Advanced Energy Studies [CAES]). Applicants will need to assess the feasibility of using these materials in their institutions' laboratories. Alternately, specimens can be analyzed in suitable facilities at the national laboratories.

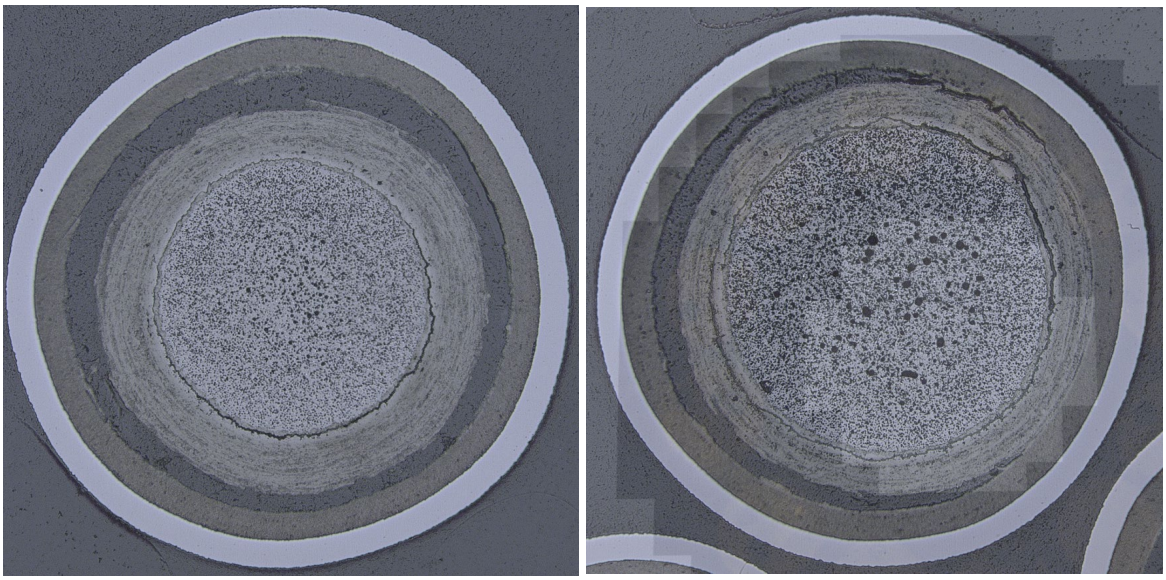
A brief description irradiated particle cross sections is provided here for information. Particles are typically embedded in epoxy and ground to near the particle midplane. At various points, epoxy is applied to "backpot" the particles and stabilize the TRISO layers of each particle before grinding resumed (without this step, significant damage is incurred to the kernels and various coating layers). Once the desired level in the particle is reached, a multi-step polishing procedure is used to prepare the particle cross sections for optical microscopy. The particles are typically backpotted such that epoxy filled gaps between layers and accessible porosity (such as that in the buffer layer). The extent of epoxy intrusion into void spaces is not known precisely; it possible that epoxy fills the entire volume of gaps, or it is possible that epoxy only fills the portion of a gap or porosity that is near the mount surface.

TRISO particle coating layers undergo morphological changes during irradiation. The figure below shows two examples of irradiated particle morphologies. The particle at left demonstrates complete IPyC/buffer layer debonding (i.e., a continuous gap exisits between the two layers, and the gap is filled with epoxy). The particle at right has partial IPyC/buffer debonding where the right side of the particle has bonded IPyC/buffer and the left side has a large IPyC/buffer gap that is filled with epoxy. It is also possible that some epoxy is in microfeatures at the apparently bonded IPyC/buffer interface. Note that these particles have had the outer pyrocarbon layer removed prior to mount preparation by oxidizing at 750°C in air. In the as-fabricated state, a fully intact AGR-2 UCO particle had 3.96E-4 g total U and 5.54E-5 g U-235. After irradiation, these values will differ based on the extent of burnup. For example, the particles in AGR-2 Compact 5-4-3 are estimated to contain 3.41E-4 g total U per particle,

1.02E-5 g U-235 per particle, and 6.13E-6 g total Pu per particle (based on physics calculations of uranium depletion during irradiation).

Due to the complexity of handling and preparing these materials, it will be important for you to collaborate on your proposal with staff at INL and/or ORNL for this work. The preparation and shipping of specimens will have to budgeted in your proposal. Some contact names are provided below. These contacts can help with establishing costs estimates for sample acquisition.
For materials and collaboration at INL: Isabella van Rooyen (Isabella.VanRooyen@inl.gov), John Stempien (john.stempien@inl.gov)

For materials and collaboration at ORNL: Tyler Gerczak (gerczaktj@ornl.gov)
For information on the PARFUME fuel performance modeling code developed at INL: Bill Skerjanc (William.Skerjanc@inl.gov)



Left, particle MNT86A-CS4-1-7 after fourth stage of grinding/backpotting/polishing. Right, particle MNT86A-CS4-2 after fourth stage of grinding/backpotting/polishing.

Q: Can you provide clarification on the quality assurance (QA) requirements for proposals?

The QA worksheet accessed as part of the application process (https://proposals.inl.gov/Uploads/QA_Worksheet_Rev_1.0.doc) provides information on the QA requirements for FOA applications (must be logged in to the website to access the link).

Q: Can you recommend some references on the AGR TRISO fuel program progress, goals, and needs?

A few selected references related to RC-4.1 and RC-4.2 are listed below.

Blaise P. Collin, William F. Skerjanc, Assessment of Material Properties for TRISO Fuel Particles used in PARFUME," INL/EXT-18-44631, Rev. 0, 2018. (Available at: available at: https://art.inl.gov/ART%20Document%20Library/44631%20Material%20Properties%20Report.pdf)

P.A. Demkowicz, J.D. Hunn, R.N. Morris, I. van Rooyen, T. Gerczak, J.M. Harp, S.A. Ploger, AGR-1 Post Irradiation Examination Final Report, INL/EXT-15-36407, Idaho National Laboratory, 2015. (Available on http://www.osti.gov)

J.T. Maki et al., "The challenges associated with high burnup, high temperature and accelerated irradiation for TRISO-coated particle fuel," J. Nucl. Mater. 371 (2007) 270-280.

J.D. Hunn et al., Detection and analysis of particles with failed SiC in AGR-1 fuel compacts, Nucl. Eng. Des. 306 (2016) 36-46.

S. Meher, I. J. van Rooyen, and T. M. Lillo: A novel dual-step nucleation pathway in crystalline solids under neutron irradiation, Scientific Reports, 8 (2018) 98.

Can Paul Demkowicz (the TPOC) provide the information on NQA-1 protocols?

Yes, there is a quality assurance document on the website. There is also quality assurance information under the nuclear data management system NDAS to explain that. Please go to the Idaho website and look at the NP mass system for a discussion about what is qualified data and what it takes to do that. There is a very specific NQA1 was accepted by the nuclear regulatory commission, and that information is available from the American Society of Mechanical Engineers (ASME). Although it is long and laborious, the specifics are given on the NEUP website, so start there. It's more than just the laboratory notebook. There needs to be qualified data that is repeatable and assurance that it was done correctly.

Is RC-4.1 focused on experimental proposals as opposed to computational?

Yes. The reason is that there has been Ab Initio modeling done for some of these, and it's not necessarily productive. Remember to look at the assessment document by Skerjanc and Collins Data has been used that has been published in previous gas reactor designs and fuel, and there is a sensitivity. If it's just a computational proposal, it will not be responsive.

The most important thing an applicant can do is experiment. Perhaps, if the applicant just wants to focus on the buffer layer and the ipick layer of bond strength that would be fine. Concentrate on one.

The experimental data that is needed is well described in the Idaho report. The list of the important parameters is available and can be obtained from Idaho report: INL/EXT1844631 Skerjanc and Collins. It was published last week.

The properties that have no significant impact are: kernel swelling rates, kernel thermoconductivity, buffer elastic modulus, buffer irradiation induced creep, buffer irradiation induced dimensional change, thermoconductivity and expansion, PYC thermoconductivity and expansion and the SIC conductivity and expansion.

The most important is the carbon-to-carbon irradiation-induced creep and strain; the dimensional change. Table 26, on page 66 of the report, shows that it is a function of radiation temperature, increased probability of failure, and it shows the resulting sensitivity factors.

The two mentioned previously were the PYC irradiation-induced creep and the irradiation-induced dimensional change. Some of the rival statistics parameters are important. The silicon carbide elastic modulus is very important and the PYC elastic moduli is also very important.