2018 CINR Workscope Specific Q&A

CINR Overview

Does the PI have to be a US Citizen or permanent resident?

The PI does not have to be a US citizen, but needs to be faculty at a US institution. Each institution determines who is eligible, so check with your contracts and grants office to make sure you are eligible to submit.

What is the status of the IRP that was on the versatile fast test reactors that was in the original scope of work?

That has a slight change in title, currently we are planning on rolling that out as an IRP. John Hercez will present that information in that particular webinar.

How many Blue Sky Proposals were funded last year?

All awards listed on the website.

If a PI has one current NEUP project that won't expire by Dec 18th, how many pre applications can be submitted by that PI?

You can submit up to six pre-applications as PI, with three as lead PI. When you get to full applications, you can only submit the number you are eligible to be on as a PI, which would be two.

What is the available funding for FY18?

Funding is currently being determined in Congress, but should not be too different from FY17, but we won't know until the FOA is released.

If a Co-PI of a R&D project moves from a national lab to a university pre-award, can the funding follow the PI to the university?

If the national lab is the sub-recipient, and it will be worked through the prime contract, and specific situations can be discussed with Aaron Gravelle at DOE-ID, 208-526-0208.

May DOE laboratory staff that have an adjunct appointment at a University lead a university project?

If that person has a formal relationship with the university and is employed by the university with a paycheck from that university, and is eligible to lead projects as an investigator of the university (determined by university), then yes.

Is this different if they have a joint appointment?
No different if a joint appointment, but depends on the details.

2018 CINR Workscope Specific Q&A

Is fundamental research supported under mission supporting work or is that only applied work that is aligned to the programs?

That would be through the mission supporting but would still have to fit within NE's mission. Those review criteria are given in the FOA. Projects sponsored within NE tend to be more applied, so please look at projects funded in the past to see what they look like.

Could you describe some situations where NEUP applications have been dismissed?

This can happen when they are over the eligibility requirement limit, noncompliant with the requirements for submission, some have been discontinued for review when requested no-cost time extensions that make them over the eligibility time limit listed in the FOA, PI asks for more money than is allowed in that category or if budget is too big.

What criteria will reviewers use to evaluate preliminary proposals?

Those criteria are listed in the FOA and on the website. These include relevancy review, program priority, technical peer review to make sure the research is achievable.

Can I resubmit my application that was not selected for funding last year, or is this not allowed?

Yes, you can resubmit but please use caution to make sure the workscope has not changed or that the change is addressed in your proposal.

In the webinar schedule, there seem to be missing workscopes (RC 5-6-7), the light water reactor sustainability scopes.

These will be presented on Wednesday from 1-1:30 pm Eastern time. Some workscopes are grouped into programs and these are listed as RC 5-7.

What is the status on the IRP EM topics from last year, 2017.

Those have not been selected or arranged by EM. These will come with EM funding and they are responsible for making those final decisions and executing those awards. Aaron Gravelle has a POC you can contact, so please contact Aaron at 208-526-0208 for more information.

Can postdocs from universities serve as PIs?

Yes, if they are allowed by the individual university, but it's a local decision by the university. Contact your grants and contracts staff at the university for more information. If postdocs move from one university to another after completing their appointment,

moving projects to another institution will be at the discretion of the policy that is outlined this year.

Are the draft workscope topics final or is the expectation that they will be changed?

There is not an expectation, but it is at the discretion of NE whether they need changes and clarifications. The most current version of workscopes will be posted on the NEUP website.

When the university is possessing key skills but lacking key laboratory space, can they buy laboratory infrastructure for the project?

In the past it was limited to the 20% rule. You can buy lab time/space and/or lease it or equipment, but you cannot build laboratories with NEUP funds.

Can you pay for lease of lab space?

Typically F&A costs cover space you many need in labs. It would have to be a very specific, detailed, and unique space tied to R&D projects. Please contact Aaron Gravelle at 208-526-0208 or JoAnne Hanners (hannerj@id.doe.gov) for specifics on this topic and concerning sub awards for this purpose.

Is there any US-UK or US-Japan collaborative work that will be going on or out shortly in this FOA?

Not is currently anticipated today, but could be updated and would come about as an amendment to the FOA. Mike Worley at DOE is continuing discussion at various locations on this topic.

Does funding allow for or grant access to facilities needed and located at foreign collaborating partners, for example irradiation facilities for materials program?

No, we cannot use US dollars to pay for facilities in foreign countries, but they could provide those facilities at no US dollar cost.

If a postdoc will join another university as an assistant professor before the full proposal is due, can they submit the proposal form their soon-to-be employer?

Yes or you could have a strong collaboration in place from the soon-to-be university to ease the tension associated with any type of award post transfer.

Are there any information technology technical areas which are encouraged to improve nuclear power efficiency?

Cybersecurity and sensors, operation of control rooms and various items in several of the workscopes.

If only a part of the NEUP proposal may require access to an NSUF facility, will the PI still need to submit an NSUF LOI?

Yes, you will either co-join it with NSUF and submit the LOI, or don't co-join it and then go through a separate application if doing a rapid turn-around experiment, as an example. Proposals must be submitted through NSUF 1 or 2 workscopes if using NSUF access. NEUP scopes will not be allowed to be submitted if needing NSUF access.

Can you give any examples of an MSI (minority serving institution) or a URG (underrepresented group) qualifications?

MSI is something designated though the Dept. of Education, an URG is a self-identification is often minorities or sometimes an underrepresented group in your field of study.

Industry FOA:

Will the amount of funding awarded in CINR affect the amount of funding awarded in the Industry FOA?

It will not, of course this is subject to change.

Do you expect a similar review process as that of the CINR or will there be a greater aspect to relevancy depending on the tier level?

This is under discussion and we have a general idea of review and award selection criteria based on successful awards from the past. For example the SBIR call from 2016-2017 it describes the criteria from which those awards were made, so that will be the starting point for the other two sections we currently envision and reserve the right to have other sections as the need comes up. For all FOAs we will describe what will be done with your application, the kind of criteria and reviews it will go through. Please keep in mind the fundamental difference of this FOA. For CINR, the department has a mission it is defined in some detail the department's needs for its sponsoring programs and we're asking for your proposals to help meet those needs. For the industry FOA, we are going to describe the department's mission, the box within NE the funding can be applied to and we will be looking for industry to identify its needs and how it proposes to join in a public/private partnership with cost share with the DOE to address those needs. To be able to do that the criteria will be somewhat different.

How will applications be submitted?

To be determined, possibly with a webinar similar to this session. It is anticipated to have outreach like webinar before issuance and start implementing the new FOA. By then we will have more information on how the process will work and go through technology

working groups and contact with NEI and EPRI and the existing fleet to get the word out and have a discussion when we know the details.

GAIN Overview and Update:

Are there any GAIN funds that are available for universities?

Gain as an initiative does not have funds for anyone, but has influence and directs funds through the voucher program. GAIN is focused on having work done through National Laboratories. CINR workscopes have GAIN fingerprints throughout and these parts of the workscopes are responsive to the GAIN community.

Are any Blue Sky ideas funded through the GAIN program or is it mostly applied research?

Gain is here to assist for any TRL, generally speaking some of the low TRL materials science research is in some of the NSUF facilities. It depends on what you consider blue sky, we see some low TRL GAIN vouchers. Generally what we like to see is a very solid plan for commercialization and a solid business plan. Very little is out of bounds as long as there is a good commercialization plan that is well thought out.

Does GAIN have an interest in advanced manufacturing of concrete shielding?

GAIN has a general interest of advanced manufacturing of all types. Concrete is definitely going to fall into this realm. You can conceive of innovation of any material production specifically involving advanced manufacturing techniques.

How would university folks make use of GAIN to establish connections to which you referred earlier?

Visit the GAIN website at gain.inl.gov where there is an email link to contact GAIN staff. Also you can contact John Jackson or Rita Baranwal at John.Jackson@inl.gov or Rita Baranwal at Rita.Baranwal@inl.gov.

NSUF Overview:

Can you clarify which workscopes industry can lead in NSUF?

NSUF-2 workscopes can be lead by Industry PIs.

Can National Lab postdocs apply for CINR at their own lab?

Yes, but the national labs each have rules on this, so consult your grants and contracts staff for details.

2018 CINR Workscope Specific Q&A

What is the deadline for the rapid turn around proposals?

Next call is currently open and closes at the end of September. These run three times each year and every 3-4 months those are awarded.

Does the CINR only accept neutron irradiation experiments?

No.

Is there an area of focus for any given proposal?

In next presentation you'll see specific workscopes that are called out for NSUF-1 and NSUF-2, which is the access-only portion.

Can DOD lab employees apply as lead PIs?

No. They can be a sub-awardee.

FY18 NSUF Changes and Workscopes for NEET-1 and NSUF-1.2

Will you need to select one of the four NSUF-2 Categories when you submit proposals this year, rather than just selecting NSUF-2?

Yes.

Can the rights of use be limited or does DOE take full ownership of material/technologies?

DOE takes full posession of the materials.

Are there any plans to add more facilities to NSUF in the future?

Certainly a possibility if other facilities apply to become NSUF partners. They would be evaluated in light of what our current capabilities are to see if they offer a unique capability or one that is over subscribed. We currently have 20 partners and a pretty good set of capabilities at this time. It would need to be something that is fairly unique.

Can we talk to a contact at DOE prior to submitting a concept for our application?

Certainly, you can talk to Alison Hahn for guidance with NSUF.

Does control materials fall within 2.1 or 2.2?

If core and structural materials, it falls within 2.1. If they're fuel related it would be under 2.2. Accident-tolerant control rod materials would be under 2.1. Contact the POC for more details and questions.

How are the NSUF-1s reviewed?

For all NSUF workscopes, reviews are described in detail in the FOA.

Do proposers have to travel to the NSUF facilities for sample examination or can they just send samples?

We encourage and prefer applicants to travel with their samples and be part of the process, especially if they are doing PIE experiments, so they can see results in real time and make any adjustments needed during the process.

If NSUF-1 research has overlapping with programmatic research, is that advantageous to the success of the proposal?

Would need more specifics for this questions, but needs to be focused on the specific workscope.

Are there specific components to which additive manufacturing methods are of interest?

No specific components but not fuel.

If a currently funded project studies material with a certain advanced manufacturing technique, can the same material be the focus of a different AM technique?

Yes.

Would you fund a project that advances construction processes i.e. construction progress and quality control?

We would have to see the proposal and see how it's set up. That's a tough call. We do look at fabrication manufacturing but have considered construction processes in the past.

What are the expensive components to fabricate currently?

Large components and single use components that aren't readily fabricated. Please email Alison Hahn directly for more information.

The current draft FOA says NSUF-1.2 is lab and university led only. Can industry lead?

Yes, that correction is being made.

Is concrete shield considered under advanced manufacturing?

Yes it's included in AMM.

Will you fund NDE for building components for nuclear power plants?

Would have to see the proposal, but this has been funded in the past, and it's been encouraged in the past.

Is there an interesting in identifying all the variables/parameters in the AM process and optimizing them to arrive at the required physical and mechanical properties?

Yes, we know this is an issue with AM and are highly interested in them.

What types of non-destructive measurements on AM components are of interest?

UT has been looked at but Alison would have to get back to you on specific other measurements.

Do you consider advanced joining or welding techniques as innovative manufacturing techniques under NSUF-1.2 workscope?

Yes.

What is the website for the crosscutting technologies summaries you were talking about?

Energy.gov/NE > Initiatives for NE > Nuclear Energy Enabling Technologies > see most recent publications and awards summaries listed there. Please email Alison for the direct link.

Are studies that characterize the material and mechanical properties of components made with AM techniques of interest?

This is a manufacturing program. There are other materials programs that research specific materials. We are looking at manufacturing processes to increase the schedule, decrease cost, increase reliability. There is mechanical testing that needs to be done with new AM techniques in general, but those material properties research would go into materials R&D workscope areas.

How do I get a copy of these slides?

The slides from all presentations will be available on NEUP.gov after the webinar.

Can I contact a program manager or technical lead to talk about your ideas for project?

Yes, you can contact them up until submission of the full proposal.

Is additive manufacturing of steam turbine within the scope of NEET-1?

Yes.

FY18 Consolidated Scientific Infrastructure FOA

Where is a list of the names of the NSUF user facilities?

Those are available at NSUF.inl.gov, NSUF/infrasctructure.inl.gov. If you have any questions, please contact Brendan Heidrick (nsuf@inl.gov).

Would the INL HPC facility provide the capabilities for running Monte Carlo neutronics codes such as NCMP and how would we get access to it?

Yes the HPC facility could provide the capabilities and you can contact nsuf.inl.gov for access to the facility. You do not need to have an NSUF project to access these facilities, but you have to have a project that is relevant to the office of nuclear energy to apply for a user account.

FC-1: Materials Recovery and Waste Form Development

Can one be leading both FC- 1.3a and b since there are two subscopes?

Yes.

For FC-1.3a Is capture of iodine the only fission off gas of interest?

Yes

Would electrochemical methods of solvents be of interest?

Yes

Is the waste form development for salt encapsulation of interest?

Yes.

2018 CINR Workscope Specific Q&A

The back end of the fuel cycle does not appear to welcome new ideas for more cost effective solutions. Is this due to the commitment with glassification as the only pathway?

No, that's not true. We have advanced glass waste form and advanced ceramic waste form. When the campaign is small, there is only limited funding for propodals. If we had more funding there would be more calls for other topics.

The FC 1.2 call basically describes the exact research that was just funded, are you looking for research in a similar direction?

No, last year it was focused on the kinetics, extraction of the lanthanides and actinides into an organic phase, then you strip your actinide into an aqueous phase the stripping was very slow last year, and that was the kinetics. This year we are talking about the degradation products. You will have degradation of the solvents. Talking about recycling the solvents and the by-products that would impede the process. This is a very different call.

Could you elaborate more on the modeling and simulation in the program?

There is no funding in this area this year.

Would zirconium oxides be of interest as advanced waste forms?

No

Is Oak Ridge's Bob Jubin the best contact for iodine off gas topic?

Yes.

For FC 1.2 is there a specific solvent to be considered?

Please contact Terry Todd (INL) who will put you in contact with folks working in this area.

For iodine capture and encapsulation, is the primary focus on silver loaded absorbent? Silver is expensive and not environmentally benign. Any interested on other advanced absorbents?

Show me you can do better than what we have now to get funding for your project.

Last year's call included opportunities for UK collaborations funded by the UK, what is the path forward on UK collaboration?

DOE is still in contact with ESPRC who has funded UK work in the past and currently there is no UK collaborative work planned. If that changes, an amendment will be made

to the FOA to reflect that change. DOE is also looking at opportunities for UK collaboration for 2019 as well.

Does the waste form from FC 1.1 have to be glassed-based or could it result in a ceramic waste form?

Yes, it could result in a ceramic waste form.

Will alternative materials for the vitrification of waste be included here?

No, alternative materials will not be considered in this NEUP FC-1 call for the vitrification of waste.

Will the PUREX process be considered in the US?

PUREX has been used in the U.S. in the past, is not expected to be important in the future for non-defense applications and so is not included in this call.

FC-2 Advanced Fuels

FC-2.1:

Should proposals include ion beam irradiations or testing on ion beam irradiated materials?

It would be very relevant if you want to look at ion beam irradiated materials and irradiations.

Are three materials that are of special interest, e.g. F/M steels?

The main aim of the call is for qualification/benchmarking of microscale testing to macroscale results with emphasis on mechanical testing that measures ductility. This work scope area is not specific to any material. However, the main program focus is on ferritic based materials for cladding applications.

Is the tested material just limited to fuel cladding or would other structural materials like stainless steels be included?

We are focusing on measurement techniques and not limited to a specific material. Any material would be relevant as long as you can demonstrate and benchmark the microscale measurement technique.

Are there specific labs or groups/individuals within labs that universities should try to partner with?

2018 CINR Workscope Specific Q&A

Specific collaborations are not required. However it is suggested that applicants familiarize themselves with the program priorities and focus areas and show a strong coordination with programmatic research.

Are there specific strain rates and temperatures that are of specific interest?

Strain rates are typical static strain rates (10-3/s – 10-4/s) and the temperature range of interest is room temperature up to 700C.

Are there specific types of conventional, macroscale mechanical tests against which small-scale results should be validated?

Yes, testing results can be correlated with ASTM standard measurements. For example, an S-1 (or SSJ2, gauge length of 5 mm and width of 1.2 mm) tensile specimen has been correlated with ASTM standard measurements.

Is there interest in mini-specimen techniques for fatigue?

Yes as that is an area that is difficult to measure at the microscale.

Could you expound on what is needed for ductility measurement techniques? Tensile tests traditionally give ductility measurement. Is this solicitation going for something above and beyond what a traditional tensile test curve can give?

The main ductility measurement that we would like is what you would typically measure in a tensile test, so that would be one area. But we also would like measurements in other difficult areas are fracture toughness, or sharpie tests would also be applicable.

Can the correlation between microscale and macroscale measurements include a modeling based approach validated by experiments?

Although modeling is not a requirement for this work scope area it is encouraged to the extent reasonable if it helps the correlation. However applicants should be careful that the experimental work does not suffer due to a focus on modeling activities.

Would it be of interest to compare the ductility in ion and neutron irradiated materials in this call?

That is the eventual application but is not required in this research.

What are the specific requirements on high temperature micro / nano indentation?

There are no specific requirements but the temperature range of interest to the program is room temperature up to 700C.

Should ion beam irradiation testing be included in the proposal?

Ion beam irradiation testing is not required but it would be of interest to show how the technique can be used on ion irradiated materials since that is one of the main applications. Previously ion or neutron irradiated material could also be used.

Will the materials be provided by a DOE lab as has been the case in some DOE funded programs? If yes, what would those materials be?

If you would like to collaborate with a national laboratory, they may be able to provide materials. Otherwise, you can obtain the materials yourself. Typical candidate cladding materials are Zirconium alloys, tempered martensitic steels (e.g. HT-9), austenitic steel alloys (e.g. 316L) and ferritic ODS alloys (e.g. 14YWT). The aim of the call is to benchmark microscale measurements with macroscale measurements. It is not required that you perform your study on these materials as long as the correlations apply to these materials.

Will those materials be irradiated in a nuclear reactor? Do we need a special facility/procedures to handle the irradiated materials? Some of the tools (SEM/TEM) are in user facilities.

The advantage of microscale measurements is that they reduce the amount of material you need to test through a smaller testing volume making it applicable to neutron irradiated materials (reducing radioactivity) and ion irradiated materials (able to test over the reduced volume of the irradiated area). If you would like to show this correlation on these types of materials that is great but not required as long as the correlation that you develop can apply to these types of materials. Neutron irradiated materials can be obtained through NSUF proposals and ion irradiations can be performed with NSUF facilities or through direct collaborations with labs or universities that have ion irradiation facilities (e.g. LANL, SNL, TAMU, U. Wisc, U. Mich).

FC 2.3:

Will be penalized if we address all three areas of the scope if we have prior experience with SiC/SiC LWRs?

Yes, you can address more than one.

What are the environments that the SiC/SiC composites are of interest to the program?

Basically you would want to check environments of the VWR and BWR that might be using this material. The program is supposed to enhance the accident tolerance of exhisting reactors. So basically it’s the environment of existing reactors that’s of interest.

Where can PIs get a copy of the ORNL Handbook Frank mentioned?

Send a request to Frank or Dr. Katoh for an electronic version.

How much simulation work is encouraged to be included in this call?

It must align with the question you are trying to answer in your proposal. The proposal could be experimental centric or modeling centric but modeling alone is not a good idea, though it depends on your approach. A modeling-assisted experiment would be fine.

Can you explain the issue with SiC/SiC composite related to radiolysis?

We have found in some tests depending on the oxygen level in the coolant, one can affect the surface of the SiC/SiC situation. It is important to look into what you expect. We know the oxidative activity of the water coolant and the radiolysis combine to create significant corrosion rate. Radiolysis assisted corrosion needs a systematic understanding and this is an extremely important question in this workscope.

Which utility specifically is willing to put materials in their reactors for testing?

This is in the hands of the vendors right now. There have been several utilities involved. There is significant interest in making reactors available sooner rather than later.

Is the advanced fuel campaign considering innovative concepts, such as Zirconium Diboride ceramics?

Although the ATF program is not at this time focusing on Zirconium Diboride ceramics, we can't rule out future considerations of such potential innovative concepts. However, at this time, under FC 2.3 we are giving Accident Tolerant Fuel development relevance priority on concepts already underway by our three lead industrial partners.

Is there any plan to pursue other ATF concepts which are potential near term solutions: for example Cr coated Zircaloys as followed very aggressively in France by CEA and AREVA?

At this time the ATF program already includes "Cr coated Zircalloy" as a concept whose commercialization we support. In fact, under FC 2.3 we are giving relevance NEUP priority on concepts already underway by all three of our industrial partners.

FC-3: Advanced Data Integration for Domestic Nuclear Safeguards

Are you primarily interested in development and demonstration in a simulation environment? Is there interest in experimentation in a lab scale demonstration?

We are open to both and a combination of the two would be ideal.

Is there a focus on aqueous or electrochemical reprocessing facilities?

There is a focus on both.

Is the virtual field test bed a computational modeling and simulation effort?

It is not a completely integrated system in the sense that you enter data, click a button, and then outputs a number. It's more of a patchwork of different models that work together. They are intended to be a model but not completely integrated. For the 2020 they have a milestone and they are trying to integrate all the models that have been pursued with modeling and simulation. Mike Miller is the POC and he may be able to answer the question in more detail if contacted.

$800,000 over three years might be less when talking about a lab-scale model. Is there a scope to allocate more funds?

Funding is limited unfortunately.

FC-4.1 and 4.2: Used Fuel Disposition

Are models for the transport of fission gases out of a repository of interest here?

Yes, but not a super high priority if you look at what has been done in the past. Carbon 14 and Radon would be of the highest interest for gases even though they are not fission gases..

Is FC 4 interested in problems in aging and degradation of cement based isolation barriers in applications to deep bore hole disposal of nuclear waste?

Proposals of this type are not being requested in this year's call.

FC-4.2 are you more interested in repair or the mitigation aspects? If cracks already exist, what can be done to fix those?

Repair is of more interest. Mitigation would be of interest in the fabrication process would be more of a mechanical issue. We are also looking at mitigation of the repair of a well, low temperature repair techniques that might not require a mitigation. Encourage those working on FC-4.2 to be familiar with the environment of the storage system, the geometry, the radiation field, the temperature field, as those will be relevant to what can actually be done.

Are models for pore scale coupling for transport in the geosphere of interest to you?

Yes.

Is hydrological modeling perhaps coupled with experimental work of interest, even as a conceptual model since no final site has been selected?

Yes.

2018 CINR Workscope Specific Q&A

Are there any studies addressing the weld failures systematically with or without exposure to postulate and ultimately coming up with advanced joining techniques?

Clarification needed on question – intriguiging concept but may not fall under the scope of 4.2.

Does FC4.2 include qualifying state of the art sensing systems for storage canisters?

We encourage proposers to be familiar with awards in this area in past years. If something on this topic has not been covered already, then it may be of interest.

Is crack initiation and crack growth study of interest?

If there is not past work in this area on a specific topic, then it may be of interest. There have been previous calls in this area.

Is novel concrete materials for dry casks being considered?

No. There have been previous calls in this area.

Do any repository geology types take precedence?

No

FC 4.2 Does not spark source preclude the use of arc welding? Also is it expected that the repair work be done in the field?

If the proposer can do it without a spark source, there would be interest. Yes, the repair work needs to be done in the field.

Are studies on repair and mitigation coupled with crack initiation and crack growth of interest?

Yes, though focus is really on repair and mitigation.

FC 4.1 can you provide more detail by what is meant by chemical dynamics?

Please refer to the text of the call for a description of chemical dynamics.

FC 4.2 are there specific stainless alloys of interest for repair and mitigation since several alloys have been used historically, if so, which are of greatest interest?

Alloys of greatest interest are those of largest use that are deployed in the field that have the greatest propensity for stress corrosion cracking.

Is disposal in environments like Yucca Mountain of interest?

Environments like Yucca would be of interest, but not Yucca Mountain itself. DOE concluded in 2008 that additional research was not needed on Yucca Mountain.

If not FC-4, which program is most relevant for isolation barriers for deep borehole disposal this year, or is it not being considered this year?

It's not being considered this year in the NEUP FY18 call.

What is the general thickness of the canister wall? Is the repair intended to be applied when the canister is in service?

Proposal authors needs to be familiar with the types of canisters in use today. Yes, repair needs to be deployed in the field for in-service canisters.

FC 4.1 Are heat and radiation minerals of interest for radionucleid retention?

Yes.

Does chemical dynamics and waste isolation barriers include effects of phase transformation on the barrier microstructure and radionucleid transport in cement based materials?

Not a high priority because relatively few disposal concepts rely on cement based barriers for radionucleid migration.

FC 4.1 Is there any interest in repair of a dual purpose cask of spent nuclear fuel?

Yes for 4.2 but not for 4.1.

Is focusing on one aspect of the barriers for waste isolation preferred or is a holistic evaluation of both engineered and geologic barriers together more desirable?

In the call there are 11 independent issues, but nothing would prevent a holistic approach. They expect to see component proposals, but would not disqualify a holistic one.

Is vitrification of nuclear waste through borisilicate glass of interest in this call?

Suggest looking at waste form part of the call for this type of proposal.

Are our repositories being designed to be recovered for future use as reactor fuel? Do all barriers allow for reopening at reasonable cost and low collapse like in salt mines?

No, and outside the scope of the call.

Are there any used fuel disposition topics for waste reuse rather than just waste storage?

No.

Are 4.1 and 4.2 the same priority from a funding perspective?

Yes.

FC 4.2 are the used nuclear fuel storage canisters to be directly disposed?

No. This addresses their performance during interim storage.

How many awards will be given in 4.1 and 4.2?

This depends on appropriation of funds, not sure at this time.

Does FC-4 cover how to get access to used nuclear fuel? In reference to an industrial or a small start up to get access to used nuclear fuel?

No.

What is the correct form for used nuclear fuel used for new fuel?

Does not apply to this call.

MS-FC-1: Fuel Cycle R&D

In slide number 2 what exactly does advanced analytical tools mean? To analyze what?

This is the processes: the aqueous, the pyrochemical processes, the electrochemical processes to analyze the flow of the materials losses so this could be related to safeguards and security or it could be related to improve the operations.

Tritiated waste separations was included in last year's program support areas but it is not in the solicitation this year. Is it an appropriate topic for mission supporting proposals this year?

I'm not sure what part of the call that was in. Our description has been very general for many years now and we never got that specific in our call here. I would say no, not for this call.

Are radiographic methods for quantifying nuclear materials for reprocessing or storage of interest?

That sounds like it is within the scope, so yes.

Is fuel cladding tube R&D part of the fuel cycle R&D?

Yes, fuel cladding is part of the scope.

The areas of interest for MS-FC-1 as described in your presentation appear to be very specific and in some cases overlapping with other FC thrusts but not very open-ended. Is this a correct interpretation?

No, I don't think so. We are looking broadly and we are not trying to be very specific. We refer to things like advanced fuel treatment material recovery, innovative fuel cycle analysis tools without limiting the scope any more than that. I would say that anything related to those five technology areas that I described would be part of the scope.

As ATF research has progressed in recent years, do you have a preference about what research you would like to see (i.e. manufacturing, characterization or neutron irradiation testing, etc.)

Look at things we are not doing already. If there are novel fuel fabrication techniques that are not currently employed or aren't being studied in the program than please propose on those topics. Any of those other areas are fair game as well.

How many awards are expected in MS-FC-1?

Probably around 2 depending on the proposals.

Can we propose new innovative cladding materials or studies of irradiation effects on them?

Yes, that would be fine. Keep in mind that these are up to $400,000, three-year awards so you might be limited as far as developing new materials but innovative cladding material would be within the scope.

With the completion of the evaluation and screening study by Roald Wigeland is this call an opportunity to improve the technologies identified in this study that did not score well and move them towards a more favorable fuel cycle?

Yes, again that might be a little ambitious for this size or type of award. Also, keep in mind what I said earlier about reactor performance or design. That would be another area than this call. We are talking about fuels, separations, etc. that I described in the presentation.

Molten salt reactors could start up using used fuel and excess plutonium. Is there a possibility to work with a national lab to create a fuel using both?

I think that his call and mission supporting workscopes are university only. The budget is $400,000 and only 20% can go to non-university partners so you can contribute an $80,000 maximum to a national laboratory partnership.

Are ion irradiation studies on new clad materials encouraged?

No, because that is being done already. Now if there's something that is new or innovative about your techniques or the way you are going about it than yes, but please read the literature because ion beam irradiations are very prevalent in this program and others programs.

Is FCM fuel of any interest moving forward?

Yes.

Relative to SNF, is DOE going to allow or create a methodology to allow access to SNF to fuel fast reactors?

Sure, that is a possibility. I don't think we would restrict that. As long as it is a new idea or approach that would be fine for this topic.

I didn't see a mission supporting scope for reactors in this FOA. Will it be added later?

The advanced reactor group has added several program supporting workscopes since last year and there are no current plans to have a mission supporting scope supporting reactor development.

RC-1: Advanced Reactor Components

Will there be more than one three-year award each totaling $800,000 for RC-1.1 and RC-1.2?

That is always a good question but that will be dependent upon the overall budgets. Historically we have had one to three awards in these materials categories but it'll be budget dependent for next year.

Can DOE or some other government lab be a sub-contractor on the grants led by a university?

I think that was address in the last topic area. Typically, non-university partners can receive up to 20% of the award.

2018 CINR Workscope Specific Q&A

Will datasets with pertinent thermochemical property and chemistry of the currently used alloys be provided by DOE?

No, but they can be readily obtained from the ASME code.

Is the objective strictly to consolidate existing databases and implement data mining or does it also include design and experimental verification of new chemical compositions of alloys having multiple properties optimized?

I will break that down in to each of the two topical areas. In both cases for the cladding and for the long-term alloy development. For the cladding, you could consider using existing materials, everything from pure nickel to some of the molten salt compatible materials that have been developed over time Hastelloy may be a good example. Anything new would also be appropriate. For the new alloys, they could be variations on materials that have been used before or brand-new materials. I know of work in some organization where they've developed some of the HEA alloys to have both higher strength and higher corrosion resistance for a molten salt service. It depends on what people want to do. We are not looking strictly for data mining. We're looking for people to come up with engineering solutions that includes development of new materials that would be good.

For RC-1.1 I want to emphasize that declared are not wrought metals. We are interested in the well metals performance in terms of salt compatibility.

Are you looking for a very comprehensive proposal which tries to cover all the aspects of interest for a material to be used in a MSR or a more specific on which may only cover a few topics such as high-temperature strength study or an irradiation damage story or a corrosion study?

We would be interested in something that covers adequately all of the parameters that are important for use. They could focus more on one than the other but the greatest challenge that we seem to see in this class of reactors is coming up with a material that is adequately corrosion resistant. We have materials that work in the high-temperature strength range and that are adequately radiation resistant for these classes of reactors. To do that at the same time as having adequate corrosion resistance for the molten salt, we don't have that right now. So, if you can't come up with something that hits all three points it doesn't quite get there. It has to be reasonably comprehensive even if there is one focus area in the proposal.

Does this cover refractory metals for clad in base metal?

Refractory metals are a possibility but in both cases I mentioned something about the fact that we are interested in having these things meet the rules for the ASME code right now. It is tough to get those included for ASME codification.

In terms of RC-1.1 for the cladding material, there are promising materials that are refractory that could be a candidate because of their very good properties in terms of the salt resistance. For 1.2, in terms of using a refractory metal, let's say construction materials, will be a little challenging because of oxidation.

On the other hand, if it were constituent in a high-entropy alloy that would probably work very well because HEAs you must have a wide range of atomic constituents to make them work.

For the near term down selection, which materials are more favored? Code-qualified or non-code qualified alloys?

We don't have a restriction but I think that we know the qualified materials well. They are not very good in terms of the salt corrosion which is why we want to have a cladding to serve the protection function.

Do these include ceramics, glasses, composites, with or without claddings?

No. We're looking for ductile materials, metallic materials.

For RC-1.1 could the clad be applied using an additive manufacturing techniques such as LENS?

Perhaps as a longer-term approach but I think that in the short term we are looking for something that can be done as a weld overlay.

It is for the deployment in terms of replication and scalability so therefore we have a lot of experience in terms of weld overlay in the petrochemical industry. If there are some innovative additive manufacturing process that is scalable and demonstrable than we would be interested to look in to that.

If part of the proposed work will unavoidably require the use of DOE user facilities not within NSUF, which requires mission and approval of individual and user proposals, how will that affect the review of the NEUP proposal?

I think that the NEUP proposal will be reviewed on their own merit. You should not rely upon any other application that has to be made for the successfully completion of your own work. So what you are proposing should be completely achievable and attainable without depending on applications from other funding sources. Now there are cases where those funding sources have already been approved and obtained. If that is the case they can be included in the proposal.

For RC-1.1, near-term research: by cladding, do you mean a thin coating to provide corrosion resistance?

I'm glad that the question was raised. We are not interested in thin coatings and thin vs. thick is a probably a relative term but we're looking for something that is more traditionally applicable to weld overlay cladding and those typically are at least a tenth of an inch and more commonly two to three tenths of an inch thick. Thin coatings, things that may be applied such as cold spray or other types of coatings that are microns thick or fractions of millimeters thick do not fall into the area of interest for this proposal for multiple reasons. One is they tend to be adherents versus metallurgically bonded. They tend to strip peel flake. They are too think to provide the diffusional barrier that is required for usage for proper metallurgical protection so in general we are not going to consider any type of thin coatings. I believe it was expressly included in the language in the call so that's why we call out weld overlay cladding as the method.

What material has been considered for overlay cladding application for structural materials?

We would like the proposers to find out such information from discussion with molten salt reactor developers.

If weld overlay is going to be considered, the corrosion study should be focused on the welding wire and its weld microstructures?

Yes, the weld wires and more importantly, the weldment.

PVD coating of refractory metal, carbon coating, TBC, plasma spray coatings going to be interested in this application?

No, they are not.

For RC 1.2, Is it possible to use a surrogate salt, or are you interested in a specific salt chemistry such as FLiBe? If surrogate salt is possible, then is there a specific chemistry you would suggest?

We are interested in structural materials that can be deployed for thermal spectrum and/or fast spectrum MSR. There is a wide variety of salts that designers are considering, depending on the specific reactor design. As we have indicated in the draft SOW, interaction with MSR vendors is encouraged for the proposers to understand the types of salt systems that are being considered for MSR applications.

The draft SOW indicates that high temperature strength, irradiation resistant, salt compatibility, resistant to material degradation due to fission products, and long-term thermal stability are some of the attributes that we seek for the new material(s). Salt chemistry and alloy composition are both important on material corrosion. Use of surrogate salts would only make sense if their corrosion effects on candidate alloy(s) are representative of the corrosion effects of the salt systems that MSR vendors are considering.

2018 CINR Workscope Specific Q&A

For RC-1: Are you interested in 1300-1400C material qualifications?

No. None of the ASME Div. 5 qualified materials could perform at anywhere near those temperatures. Applications to a maximum of 850-900 degrees C would be the upper limit of interest.

In the NEUP BAA, the RC.1.1 and RC.1.2 are looking for innovative materials. I was wondering if there is an interest in the high entropy alloys. If so, is the interest more towards making such materials (through trying different combination of components and experimenting the properties) or to evaluate certain properties of a number of candidate potential materials that are already of interest. I think high entropy alloys have allot to offer. But, I am not sure if that is what these two work scopes are looking for. Any advice would be greatly appreciated.

RC-1.2 has stated that high entropy alloys are materials of interest as they could potentially offer the type of properties that are required for the Molten Salt Reactor applications. We are looking for innovative approaches to speed up the discovery process.

For RC-1.1, the properties requirements for cladding materials for structural components are slightly different. High temperature strength is not as critical as it would be provided by the base metals, which will be limited to the ASME Section III Division 5 Class A materials, for the cladded component concept.

If you have not done so, I would encourage you to look at the webinar presentation by DOE on RC-1.1 and 1.2. You can find that on the NEUP.gov website.

We have selected CP Ni and CP Mo as clad overlay materials based on prior literature and our preliminary work. We are not proposing any integrated computation materials engineering to down-select a collection of existing alloys. Is this acceptable?

The use ICME to accelerate the downselection process is just a suggestion. Justification would always be needed to show that the required/desired properties are achieved in the down-selected cladding/base metal combinations.

We have down-selected materials cladded with process that is untouched by research community for MSR application, viz, explosive cladding. Is this acceptable?

We want cladding processes that can be applied to molten salt reactor welded construction for vessels, storage tanks, piping, pumps, valves, supports, and core support structures, etc.

Characteristics of the cladding materials to be considered include ductility measurements; is the proposal looking for ductility of the as-cladded plates

or changes in ductility after irradiation, or both? Note that ductility after ion-irradiation can only be obtained using micro-mechanical test techniques such as micro-tensile, and micro-bending experiments, since the volume of irradiated material is limited by the beam energy to depths of fractions of a micrometer to several micrometers, making the investigation of bulk mechanical properties unachievable.

We want the as-cladded material to exhibit adequate ductility at high temperatures and in the salt and irradiation environment for the intended design lifetime.

Characteristics of the cladding materials to be considered include irradiation damage resistance: Does this mean measuring mechanical properties alone or an integrated mechanical property- microstructural analysis (requiring TEM investigations)?

We want the cladding material to have good irradiation damage resistance so that it can be used for the intended lifetime for the cladded component. Traditional irradiation damages such as hardening (loss of ductility), swelling, helium embrittlement, etc. come to mind.

Characteristics of the cladding materials to be considered include fission product embrittlement resistance: Are there any particular fission products that are of special relevance (such as gaseous products, vs. La, Sr etc). We consider fission product embrittlement resistance to be a special case of irradiation damage. Hence the same question as above also applies: Is the FOA looking for measuring mechanical properties alone or an integrated mechanical property- microstructural analysis (requiring TEM investigations)?

An example of fission product embrittlement is the grain boundary attacks of Hastelloy N by the fission product tellurium leading to stress corrosion cracking as observed after the Molten Salt Reactor Experiment Project was concluded.

In the FOA it is stated, "A plan should also be developed for intermediate term testing to confirm the favorable characteristics observed during the relatively short time frame of the NEUP project and to close any gaps that might exist, e.g., confirmatory neutron irradiation testing." What is meant by intermediate term testing? And what is meant by closing any gaps that might exist, e.g., confirmatory neutron irradiation testing?

The duration of the NEUP is 3 years so the maximum duration of mechanical properties tests, e.g., creep, creep-fatigue is limited by this duration. Generally, before venturing into very extensive testing to qualify the material to support long design lifetime (e.g., 60 years) testing on time dependent mechanical properties beyond the NEUP effort is desirable to confirm the expected performance of the mechanical properties based on the results of the NEUP project. This is what the so-called intermediate term testing is about.

The NEUP project is for 3 years, nominally. Within that short amount of time, there might be tests, studies that could not be fully completed. These are the gaps. As an example, if ion irradiation is used to gather trends on neutron irradiation resistance, what will be the type of studies, tests to be conducted beyond the NEUP project to confirm or refute the trends obtained from ion irradiation results?

RC-2: Salt Behavior in Molten Salt Reactors

What specific materials are of interest in regards to corrosion?

Those questions are answered in the RC-1 workscope discussion.

Is there a preference given to neutron vs. ion irradiation for fuel salt irradiations?

At this time we're in a data capturing mode. I don't believe we have any preference of one or the other.

Is optical characterization of salts with corrosion products of interest?

Yes.

Is the thermochemical databased focused on experimental or modeling aspects?

It's hard to make modeling equations without having empirical data so I would say that the both of them are important but I would lean on experimental aspects since modeling, if done correctly, should have quantitative and empirical data to support it.

Are particulates for corrosion expected?

Again, I think that is an issue that Bill Corwin would be better able to discuss. I would lean to saying yes to that issue but please contact Bill Corwin for details.

For RC-2.2, is there a preference for fluoride fuel salt or chloride fuel salt?

The overwhelming information that we have in our legacy for data mining will support fluorides. We currently have many projects that are supporting the chloride reactor version so we don't have a preference. We would be seeking information that would support both. I want to provide as much of that detail and legacy of information over the last 50 to 60 years which could be mined from OSTI.

Particulate change the transport of thermal radiation. Are models that encompass particulate scattering of thermal radiation of interest?

Yes. I would say that would be of high interest to us.

For RC-2.2, should the thermophysical property measurement be separated from the fuel salt irradiation measurements?

I think that separation would be a necessary part to accurately quantify that information and send it forward to us. The mechanism by which you do that should be recorded so we can fully understand if they are separate or combined.

RC-3: Experimental Investigation of Radioisotope Retention Capability of Liquid Metal Coolants (Sodium and Lead)

Is there interest in the development of intrinsically stable fast reactors?

That's a very broad term. For this particular scope we are very specific about what we are looking for in terms of radionuclide retention analysis for both sodium or lead fast reactors. It does play overall in to inherently safe fast reactors. That's sort of the main phenomenon for advanced reactors is passive safety and inherent safety in the fuel forms themselves.

Do you want all four items to be addressed in one proposal?

These are just key areas and they may interplay with each other in terms of the radionuclide retention analysis. If it is possible it would be beneficial to address all phenomena but we will look at those applications that simply address the specific phenomena out of the four.

RC-4: Advanced Reactor Development

RC 4.2: Will advanced modeling on MSR in this area be considered?

If the scope is complimentary to MSRs then it will be considered, but there are other calls that are specific to MSRs. The focus is on modeling and capabilities that support FHRs right now, though there is overlap in the technologies.

Is there interest in measuring optical properties of molten salts versus temperature?

Not this year, this topic was the subject of last year's calls.

Is there interest in development of thermal transport modules for hydraulic code in the NEAMS toolkit for molten salts?

Needs to be specific to fluoride salts, please review projects awarded last year; not seeking to have the same capabilities developed where there is an ongoing project or initiating project on that topic.

2018 CINR Workscope Specific Q&A

For FHRs, which designs are you pursuing for modeling and simulation, i.e. pebble bed or prismatic types?

We are seeking to support general capabilities; now a currentl US vendor looking at pebble bed, but looking to support them with capabilities and nay FHR design.

What materials are of interest for corrosion testing?

Interested mainly in nickel based alloys or corrosion control schemes for iron based alloys. Looking at alloys you might use for an FHR primary salt-leaded containment.

Does a proposal need to cover both of the two topics flow loop and dynamic modeling or only one topic?

Only one topic is expected since they are both quite different, but you can cover both if desired.

Is there interest in studies the optical scattering properties of erosion particulates in molten salts?

Call tailored to fluoride salts of high temperature reactors and do have previous year's scope on optical properties, but if you find scope that can fit the needs and has not been covered yet, it will be considered. We are not expecting in an FHR to have a lot of suspended solids, so we are not expecting substantial erosion problem. If you think that's different or are going to operate at a different velocity where the salt itself would provide erosion, you'd need to explain your design rules are. We are currently not expecting erosion in clean salt flow.

Can you elaborate what gaps you are hoping to fill in these three areas 1- neutronics, 2- thermal hydraulics, 3- systems modeling?

Interested to have tools as listed in the call that are more widely used and easily shared. Dynamic modeling to help control design and accident progression. Core neutronics modeling to understand the physics response of reactors throughout their life cycles. Don't currently have a pebble bed core neutronics model in any of the NEAMS toolkits, and would like to have one. Don't currently have accurate thermal hydraulics models in fluoride salt flows, and would like to have that in the set of modeling tools**.** Two integrative research for salt-cooled high temperature reactors currently ongoing, it would probably help to make yourself familiar with these projects so you are not duplicating their efforts.

Why does the NEAMs toolkit get priority over other projects?

DOE is focusing on the NEAMS toolkit now, so it makes sense go forward in that path.

2018 CINR Workscope Specific Q&A

4.1- Will the experiments proposed within the scope be limited to use existing test facilities in labs?

No; it's not a requirement. Two large integral facilities at OSU and Argonne that are related to the scope are available for use. What is missing in a large validation pyramid for any type of reactor plan is a lot of the separate effects tests that would complement what is already going on there. There are a couple of NEUPs that have used their funds to build new separate effects facilities and they have revealed valuable data. We ask that we are given a common scaling to one of the reference reactor designs and try to work with the design to come up with a scalable and come up with a way the local separate effects test data can be integrated with the data that is already out there.

Are specific geometries of greater interest for heat transfer experiments?

There is a need for validation data between pebble bed and reflector interface; problems related to geometry and heat transfer. Bit of a stretch to focus it on the scope, but not impossible. Form losses and inlet/outlet plenums, bundles, tubes, number of areas that the geometric form loss information would be valuable and of interest.

4.2 – Even though a NEAMS toolkit proposal is preferred, would non-NEAMS tools still ok and could potentially be funded?

Yes, but the priority is for NEAMS; could also just provide data in a form that could interface with NEAMS tookit.

What specific thermodynamic properties of molten salts are being requested and over what temperature ranges?

There is not a specific request, more talking about using the loop and facilities and losses that are going on. Upper temperature limits of the loop are 600-700. If doing pressure drops measurements in the loops, work within the flow range and with resistance capabilities of the existing system. Measuring thermos physical properties would not really be a good use of the loop.

Will international collaborations be looked on favorably?

International collaborations are encouraged, but be aware international collaborators cannot receive US funding, so they have to provide in-kind resources, or their own time or potentially funding through their own government.

Flow loop testing – would hardware purchased with R&D Funds belong to the university? Could it be allowed to install the flow loop at Oak Ridge for testing?

Following a normal contracting process, it should be able to be done. Contracting personnel should be able to answer that question.

2018 CINR Workscope Specific Q&A

IRP-FC-1 and RC-4.3 Workscopes

Should the IRP team be integrated with all the labs (INL, ANL, ORNL, LANL), or only one or more?

The main teaming partner will be the INL and they will make the decision about what other labs based on what specialization they are working on.

How many IRP topics are there?

Only one although we haven't finalized the sub-topics. The topics will focus on safety analysis, core physics, and reactor control and design safety systems. Those will be in the call. We may add structural analysis and seismic isolation.

Will LEU fuel developments be considered?

The reactor will initially start up on LEU fuel, Uranium 235 but used fuel that contains plutonium which may be required to bring the flux level up to the level we are interested in.

Will the concept be similar to the one proposed by ANL and INL or can it be different?

Concepts will be laid out through an integrated team with INL being the lead and those concepts will be selected by the laboratory team and those will be the concepts for which the work will be performed against.

How many IRP projects are expected to be funded through this opportunity?

At this point and time we are thinking one IRP and we will find out how it goes. If it goes well we will ask for more in the future.

Do you know when the description of the workscope will be posted?

The description will probably be posted in the early December timeframe. If it's possible to get it out earlier we will try to get it out then.

Will international collaborations be encouraged?

At this point and time, no.

Does safety analysis include shielding structure or is it only for the core?

It will include shielding as well.

The new title of the IRP looks like a similar to request to RC-4.3. Does this affect the viability of RC-4.3 of being funded?

No decision has been made at this time.

Could you describe the RC-4.3 topic area?

We are looking for expertise in sensors that can be put into fuel and collect real-time data. This is in extreme environments. Sensor that can hold up as a function of time during the experiment. The experiments are not going to be years they are going to be three weeks to three months, maybe six months at the very most. We are looking for the development of advanced sensors that can stay up within that environment of a high neutron flux, high temperature and can transmit that in real time to a data collection system.

RC-5: Data Science and Big Data Analytics to Improve Nuclear Plant Efficiency

Why doesn't aging and degradation include steam generator issues being that they are the second most problematic area after fuels?

We have a limited budget and we have to pick the areas that we want to focus on and I think the feeling is aging of steam generators is being addressed in the industry and often time through replacement. There's a lot of industry involvement in steam generators so it's a good area but it's not one that we chose for this year.

You mentioned Lithium-7 for chemistry control. Are there any projects that you have in mind or are aware of?

We have some ongoing work with EPRI related to recycling of Lithium-7 that's used in plants for chemistry control. Most of the Lithium-7 that's used in the plants is essentially thrown away at the end of the cycle and then they have to add more. All the lithium-7 that is enriches is produced currently in Russia and China, so there is concerns about limited supply. So if we could recycle the material that is in the plant, and actually the boron that is added to the plant captures the neutron and decays lithium-7. So actually lithium-7 is produced in plants while they operate but it is all thrown away as the waste stream currently. We are working on that project.

There is also some work on technologies that can enrich Lithum-7. It would be needed for advanaced reactors, particularaly the molten salt reactor, it would need a lot of Lithium-7. There are technologies related to enrichment and we are also looking at (with EPRI) of the possibility of switching the current chemistry in pressurized water reactors to potassium-based chemistry it would solve some of the supply issues by getting off

lithium. Changing the chemistry in a plant is a big deal because it could affect the materials degradation of the plant if you change it. There is also chemistry related degradation research if there is a switch. There is a feeling that potassium may actually be better than lithium for degradation control. There are some plants in Russia that already use potassium.

Are neural network methods for analyzing heterogeneous data streams of interest?

I think neural network approaches would be applicable but it would be up to the proposer to advocate for how that's relevant and how that's applicable to the particular call. Again, neural networks would work well particularly for certain types of data but again the particular proposal would have to establish how the neural networks were going to be used with what types of data and how that was valid and appropriate for the types of data and what benefits would be available in that type of approach.

Are there any large heterogeneous data sets available within DOE and will they be provided for research to perform fusion and advance big data analytics?

I'm not aware of any large data sets with heterogeneous data like what we're envisioning here for improving or optimizing plant operational efficiency and even if they were available from DOE they wouldn't be applicable to the problem at hand that we are proposing to target with this funded research. However, the question raises an interesting point which is in order to do this research there might need to be a cooperative agreement with an operating nuclear utility to gain access to this type of data. That is something that the proposal should identify and if that's necessary then on behalf of the proposal, if something was successful, we would attempt to reach out to a utility and establish an agreement like ones we have with other R&D activities.

What sorts of specific insights are sought by analyzing heterogeneous data streams?
I think that's up to the proposer. Obviously economic and efficiency improvements are the focus, so how the data could be used to provide those economic and efficiency improvements are up to the proposer.

I think that nuclear power plants have been advertising very openly the fact that they're under extreme cost pressure both internally from the rising costs and reducing revenues. So when you look at that a lot of it is internal factors. The fact that they are very labor intensive. So the question is how can we use operational data to optimize work processes to improve safety? I would leave it up to the proposers to contact an owner/operator and partner with them to look at the available data and literature from operating events and other sources to gain some insight as they develop their proposals and also review some of our published research because there is a lot of published research on the challenges of these existing power plants. They would be good starting points.

Are there any preferred sensors to develop the heterogeneous data stream?
I don't think this is the focus. It is not focused on sensors so they certainly could propose what data they would want to collect and if a sensor was needed then that would be a factor. The call is what you would do with the data.

EPRI has a database of performance demonstration for data analysis from the utilities. Is there an opportunity to access this database and use the data there?

That would have to be worked with EPRI directly. It's really light water reactors sustainability program we have a Memorandum of Understanding for research with EPRI. This specific data source is not currently available through that MOU. We would have to ask EPRI about that. I believe the proposer could also contact EPRI and find out if they would be interested in supporting the proposed research through collaboration in the application or use of the database.

Is there any way to use IOT to collect data and use them for big data analytics?

The internet of things is sort of a broad categorization of communication protocols that are available from different devices to communicate wirelessly or using other communication protocols to transmit data so IOT may be available but it depends on the particular device and particular components. I would say for plant components that are part of the plant instrumentation and control system today that would be a no. Not unless the sensor is added after the fact and it wouldn't be for any control purposes. So IOT is possible for certain things but it depends on what you're thinking about using it for.

It sounds like RC-5 is more focus on large scale nuclear data within DOE. Is that correct?

No, it is what data is available at an operating power plant. DOE does not own a large scale nuclear power plant, only research reactors, so we are looking for industry data, not DOE data.

RC-6: Evaluation of Potential Improvements to Risk and Economics Resulting from Accident Tolerant Plant Designs

While RELAP-7 remains under development. Can proposals use more ready tools like TRACE?

That would be acceptable.

What flex equipment is expected to be available and how soon after an event?

The flex equipment is already in place at the plants and at the regional centers. I know there is a timeline for the flex equipment. I think done at on-site flex equipment the take credit for availability within 24 hours and I think the regional equipment is available within 72 hours. I think that's the general outline that the industry has. I think if the flex

equipment on site could be deployed sooner and you could demonstrate that was a capability of the plant maybe you could take credit for that. If you could change the operational boundaries for that equipment, possibly, and then take credit for that equipment. Right now there is no credit given to the traditional safety analysis of the plant taken for the flex equipment. That's part of the analysis. It would be looking at the so-called flexibility of using the flex equipment and taking credit for it.

I want to emphasize one point about RC-6 that's important to look at. Accident tolerance in terms of system levels there is a substantial program in the accident tolerant fuel DOE program. We are looking for more accident tolerant features as a system instead of fuels analysis. This is a topic we are very interested in. This call is looking at a systems analysis of the entire plant and how the whole plant would react to certain changes. It is looking at overall performance. Fuels is one system component in conjunction with everything else.

How broad is RC-6 intended in regards to advanced features?

We are open to any changes, we are looking at existing plants and there is a lot of resistance to making significant changes because of the high cost. Installing large systems in the plant that would take a major back fit would not be realistic. If you could install a small pump that is a reasonable cost could be incorporated with other changes. You could change the operational use of the current components, like the pumps, in different modes than they are currently used in to stretch out coping time. It is the potential of these ideas that would make the best economic case for the plant. There has to be a business case to make the changes and how would it perform better economically in the future. The focus is on the long-term economic viability of the plant and the changes would have to improve that situation.

Are any experiments associated with design enhancements such as ATF with improved operational control interesting?

We would not expect any type of experiments if that is what they are asking. We don't need any performance experiments related to these changes. We are looking at the analysis methodologies, not testing the performance of the potential changes.

For RC-6, it seems to be in conflict with RC-7. Could you comment on the differences between the two areas?

RC-6 is focused on a systems analysis looking at the economics of the changes. RC-7 is focused on what changes could be done using existing systems to lengthen the coping time so it's very specific to that scenario.

Is use of wireless devices allowed in nuclear power plants in the United States?

Yes.

Are system analyses that look at river/ocean/lake temperature rise on existing power operations interesting?

I suppose it could be included because we are looking at potential changes in the plant environment but the focus isn't on addressing change in flooding or seismic scenarios. It is focused on improving the economic performance of the plant.

RC-7: Innovative Methods for Increasing Passive Safety Response for Existing Plants

Many passive concepts have been designed for GEN III+ light water reactors. Are the passive concepts in this workscope intended to be totally new or can we examine existing passive designs for the current fleet of commercial reactors?

The focus is on existing plants so if there is a GEN III+ technology that was developed that could be applied to an existing plant that would be applicable. An AP-1000 where they use cooling water outside the containment vessel during the early stages of an accident that is similar to flooding the head of a BWR reactor provides a path for the heat to be rejected to the environment. Those are applicable.

We are looking at existing plants and ways that you can use things like natural convection to give the structure that exist in the plant without, or less change, to the plant the better. Stitching this all together with ATF and other research areas we're pursuing which is increasing the operational envelope of water pump operations from an engineering viewpoint is important. This is focused on engineering rather than the risk analysis in the RC-6 pathway.

Do you prefer to cover both ATF based approaches and other novel approaches or to focus on novel approaches that are outside of ATF?

Whether the whole program related to accident tolerant fuels. So the focus isn't on developing novel accident tolerant fuels as part of this call but you can include an accident tolerant fuel as a part of a set of changes that you would make in a plant to achieve long-term coping time that would be acceptable. You could pick one as a proposed methodology along with the characteristics of that fuel that you would expect to achieve and how that would fit in to your analysis.

The RC-7 workscope specifies using existing equipment however some modification would need to be made in order to improve system response. What is the extent of acceptable modifications and new equipment additions that would be acceptable? (i.e. a new type of injector)

I wouldn't rule out anything in particular but certainly we are focused on using existing equipment because that is much cheaper and easier to use. If we are talking about modifying the operational envelop fo the existing equipment of how it's used like

lockouts and safety features that would have to be disabled to operate it in passive mode. Those are well within the scope. If it was a relatively minor backfit that could be included. If you are talking about major changes to the plant I think realism of the likelihood of implementation would drop.

Should economical safety solutions be a key element of this proposal?

Yes, I think so, I'm not sure what that is referring to. I would just say that economics is clearly a key element of it and that is tightly coupled to the extent of any modifications you would need to make to the plant. So the less changes you would have to make it's more easy for industry to adopt it and use it. The economics increases because of that. That is an important aspect if you are talking about any major modifications that affect safety systems those are very costly. The idea is to propose things that would be able to integrated into the plant structures as they exist now and increase passive heat rejection while incorporating some of the aspects of accident tolerance. The ultimate goal is to try to get to 72 hours with the core intact and without venting. Whatever you can do to get that make the proposal more attractive.

Is it practical to add a piece of equipment, such as a new type of injector, into existing equipment for the innovative passive concept?

It is difficult to say if this is 'practical' as the question asks, and unfortunately it is difficult to answer how an injector would improve the operation of a piece of plant equipment from the limited information in the question. It is possible to propose new technology as a part of this research if it is demonstrated as a needed part of the development of capabilities and associated methods for data analytics related to some aspect(s) of nuclear power plant operation and performance (as described in the call).

Under Adv II&C: what sorts of specific 'insights' are sought by analysing heterogeneous data streams?

We are not attempting to specify the type of specific insights sought by this research or researchers, but rather encouraging the development of advanced data analytic methods that can analyze data, including data streams including heterogeneous data to optimize plant performance, improve operational efficiency and safety and such. In this sense, a heterogeneous data stream refers to data arising from a process or set of processes related to systems including work activities that are inherently dissimilar in key features such as content, format, frequency and duration in time represented by the data, etc., and that would ordinarily be difficult to analyze using conventional data analysis techniques.

Can we combine Machine Learning with it?

Assuming for this discussion that the context of the question refers to combining machine learning as a part of a proposed research approach to analyze heterogeneous data streams, then the answer is 'yes'; there is nothing to preclude that in the proposal. The organization proposing the use of this methodology will need to establish the need or

value of the specific method, that is Machine Learning, in the context of the specific proposal.

NEAMS-1/2: Nuclear Energy Advanced Modeling and Simulation

NEAMS-1.2: To enhance 3-D multiphysics BISON validation the mulitphysics is in terms of different physics coupling or just BISON plus MARMOT?

Can you elaborate on the need to enhance 3-D simulation capabilities and validation using BISON?

I do have an example. We have been engaged with Halden to conduct missing pellet surface experiment. Missing pellet surface is a known problem and is important to NEAMS and CASL and to industry. It's a problem that is three-dimensional and therefore you need to validate BISON using three-dimensional data which we didn't have and this is an experiment that is design to get three-dimensional data that is useful to validating BISON and because BISON would be used in 3-D mode to simulate the pellet clad interaction that results from the missing pellet surface defects. So the experiment is one that will be extracting data. We actually used BISON to design the experiment and BISON will be used to analyze the results but the results themselves will then be used to help validate BISON because of the particular advantage of having the 3-D data. This is a big experiment but we are hoping that there are some smaller scale efforts that would take on three dimensional problems that need three dimensional validation.

Are foreign nationals precluded from working on certain codes?

I'm not going to answer for all the labs and all the codes but it is possible that there could be some restrictions for codes used in combination. That can be addressed on a case-by-case basis. There are no blanket prohibitions on foreign nationals.

Some of the codes, particularly in the fuel modeling area, tend to be export controlled. It doesn't mean a foreign national can't have access to them per se, but a security plan and approval of it would be required. You can't assume up front that a foreign national will absolutely receive access but it is possible.

Does NEAMS support the collaboration between U.S. universities and industry partners outside of the United States?

I think the relevance might be less only from the standpoint of the need to meet the urgency of domestic customer's needs. The advanced reactor development firms come to mind. I would be hesitant to say that we would consider something of less value because it involved international partnerships. I could foresee that they could give us a large advantage by bringing in data and expertise and capabilities that would enhance a project. It would probably be okay.

2018 CINR Workscope Specific Q&A

Is reduced order modeling only of interest in the thermal hydraulic workscope? It seems that reduced order modeling would be useful elsewhere.

I think implicitly in the fuels product line, BISON is designed to run as a reduced order model or tool based on being informed by higher fidelity mechanistic models in MARMOT. Implicitly we recognize that and across the board with NEAMS if there are ways of getting faster running, more compact tools into the hands of users we would welcome those ideas. Specifically, for this scope and this call, the reduced order model approach to help is for that one scope.

The reduced order modeling, much of the materials models in BISON are most certainly reduced order models from something much more mechanistic and sophisticated often times developed using MARTMOT of lower length scale tools which then required a reduced order model to upscale them to BISON. Although it may not explicitly be said in the calls for 1.1 and 1.2 that certainly the spirit of what we are looking for.

The present NEAMS call seems to emphasize ferritic/martensitic steels and metallic fuels than past calls. It appears to put less emphasis on UO2 and Zircaloy than in the past. Does this change signal a long-term shift in focus?

We've always felt like we were on a trajectory in NEAMS to expand BISON into other fuel forms and so we don't think this as a change, we think of it as a continuation of a process that we have been following. You are seeing the emphasis move to those other forms as we are ready to move ahead.

It is a natural evolution of the UO2/Zircaloy was attacked first for a lot of reasons to demonstrate the validity of the Multiphysics multiscale modeling approach. We have done that. We are not done with the LWR fuel system but it is quite mature and now we are ready to bring on some other lines of attack. Metallic fuels are certainly a need in the advanced reactor community so I think you are going to see that for the next few years.

Would there be an interest in using flow induced vibration data of a full-scale reactor for use in benchmarking computational fluid dynamics and computational structural mechanics codes?

We have to be careful our scope was and felt we had to narrow it down to stay within a realistic boundary of our projected investment. In this case, for this scope, we weren't looking for that. We had to choose carefully because of limited funds.

Those kinds of capabilities were pursued under high impact projects with NuScale but it is not within the defined scope. If there is a proposal submitted along those line I am afraid that would probably be ranked relevant so I would discourage the development of that proposal.

For NEAMS-1.4, are there specific examples on the working fluid or applications where there's' a need for modeling the mixing and thermal stratification in large volumes?

The specific target application would be a liquid metal cooled fast reactor, either sodium or lead cooled pool type concepts with large plenum. In system analysis tools these volumes are typically modeled as perfect mixed volumes and it is prone to errors. In CFD approaches, it is too time consuming. It could take several weeks to months to simulate the stratification phenomena in large volumes. So the thrust of the call is to develop reduced order models that could be implemented in system analysis tools like SEM and doing that using our CFD tools like NEK-5000.

Is there interest through NEAMS-1.3 in the development of rapid methods to augment the toolkits computation of reactivity coefficients in fast and thermal spectrum and advanced reactors?

$MC^2$3 is the cross-section generation tool as part of the PROTEUS code system. It has both thermal and spectrum cross section generation capabilities. In recent years, we've added transport software capabilities in to $MC^2$3 to address heterogeneities and the intent is to improve the computational performance of that solver by parallelization and other enhancements so that the computation time and computational requirements are significantly reduced to make them more practical.

Does NEAMS-1.1 support the work using a combination of the DFT and MARMOT codes?

In 1.1, the focus is on developing new mechanistic models using microstructural level physics. That includes MARMOT as a microstructure evolution tool and enhancement to it. MARMOT only works with a lot of input from atomistic and low length scale packages that those types of folks use. NEAMS itself doesn't develop any of those low length scale or atomistic tools. Most are publicly available, open source. Researchers will use those to generate the inputs they need for MARMOT to investigate microstructural behavior to develop a reduced order model that can go in to BISON.

Will these codes be qualified for NRC acceptance?

That's a question that remains to be answered. Certainly, we are hopeful that our tools will be useful in regulatory space. We are engaging with the research side of NRC to see where they might have an interest in our capabilities and to exchange information. We're also trying to build a good solid working relationship with them so that their understanding of what we are doing might help provide them with some useful insights. We are also looking for some useful feedback. NRC has expressed some interest in how our tools might be helpful in evaluating advanced reactor concepts in the near future. It also depends on how industry uses them. Clearly some of our tools are already being used to optimize designs as with NuScale and the high-impact problem Tanju referred to but also in other ways. It also provides reference information and improve their analytics and

to enhance their use of their other legacy tools. So, there's any number of ways they can be used and to the extent that they must be used in conjunction with a license application we would, through the GAIN framework, would try to provide as much help as we could. A lot of this requires the involvement of a particular industry. It depends on a variety of things, including how well we proceed with developing and validating these tools, how much they are used by industry, and how prepared industry is prepared to include them and take them forward to the NRC.

Can you elaborate on the needs associated with NEAMS-1.3 advanced uncertainty analysis for MC^{2}3 ?

I think it's a general invitation for adding uncertainty quantification capabilities into MC^{2}3 to address propagating uncertainties associated with the cross-section into the calculations with PROTEUS. Any creative ideas from university teams would be welcome.

It appears that this call focuses on materials science aspects of molten salt reactors. This seems to imply that other NEAMS elements are sufficient for MSR simulation. Is this accurate?

No, I think NEAMS does not distinguish individual reactor concepts: molten salt, sodium cooled, lead cooled, gas cooled are also included in the scope. The DOE-NE's ART program has specific calls addressing the individual concepts but I think that is presented differently than here.

In NEAMS-1.1, are you interested in UN fuel and Zr-based cladding material modeling (i.e. fission gas interactions and corrosion)?

We are not specifically asking for UN fuel in this call, not that it won't rise to a level of interest again. There isn't much there. Zr-based cladding is fair game especially if it is a zirconium alloy for use, or potential use, in LWR fuels.

Is there scope in NEAMS-1.1 to develop systematic DFT generated databases of properties from MARMOT that are meant to tackle questions such as modeling phase stability and interface energies under irradiation?

We are not looking for database generation in a broad sense if that is the real part of the question. If it's developing more limited sets of data needed by MARMOT to run specific problems like what are listed in the call than the answer is yes.

Which specific molten salts are you interested in? Specifically what energy ranges are relevant here for thermal scattering?

Primarily the molten salts for thermal scattering are the FLiBe based salts and FLiNaK, there is interest in that area. Those are the two that have percolated to the top as far as industry interest.

For fast spectrum, chloride based salts would also be of interest. Fluoride based is also of interest but not for thermal scattering.

If the proposed research meets two workscopes, for example, NEAMS-1.1 and MS-NE-2, can the pre-application be submitted to both at the same time?

No, one application has to be submitted to one workscope area. If there are duplicate applications they will be dismissed and we will ask the individual to choose a workscope. An application should also stand on its own, not relying on another proposal for completion.

At this point and time for NEAMS, which codes are being modified or thought to be used for molten salt reactor analysis?

The spectrum of the RPL codes that involve MC^{2}3, PROTEUS, and also SEM for system analysis modules and Nek-5000 for CFD, and to the extent that the simulation would require response of the reactor vessel, Diablo. Those would all be applicable to molten salt needs. Additionally, as the plans continue to emerge that the CASL and NEAMS programs will be combined somewhere in the future we are interested in combining the SHARP-based CFD and SAM codes into the impact core simulator as well. That would be a good collaborative effort. In the case of fuel forms for molten salt it would be BISON.

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

For MS-NE-2 workscope, does this applied code system have any preference or any program designated toolkit?

No, any applicable toolkit that is useful for the programs that we've mentioned before that are used for DOE sponsored programs or industrial applications would be suitable.

Is experimental data on drying processes of nuclear canisters data in the scope for MS-NE-2?

This scope is more about the fundamental nuclear data. As some sort of mechanical performance that would not be of interest. We are making a small contribution here so this is not a huge scope with a large amount of funding so we have to be selective. There are six basic steps to getting the data deployed to the NNDC for being evaluated and incorporated into NDEF. If there is a proposal that starts off with step one and two and then hands it off to someone else there is a real risk there to the proposal. We want to see a narrower scope that covers all six steps.

MS-NE-1: Integral Benchmark Evaluations

No questions.

NEET-2: Advanced Didgital Moonitorig and Control Technology and NSUF 1.2: Testing of Advanced Materials or Advanced Sesnors for Nuclear Applications:

NSUF 1.2 – How much can be proposed to support the irradiation costs?

Up to $1.5M. The R&D portion can be up to $500,000, if you need irradiation it's up to $1.5 M, if you need PIE up to $4M, if you need access to a beamline and PIE it's up to $750,000

What type of sensors would be of interest?

Sensors that would help with monitor active equipment or whatever your proposal addresses.

What are the differences between NEET 2.2 and RC-5?

RC-5 is focusing on existing light water reactors whereas NEET 2.2 is very broad and focuses context for advanced reactors and on big data as well.

Is there any way to submit a proposal on sensor for occupancy counting using machine learning?

Not sure, they would have to see the proposal.

For NEET-2.3 what are the highest-priority sensing needs?

It would depend on the application. Sensors that can be deployed in-situ in nuclear power plants that don't require power and can transmit wirelessly because they could be used immediately. Things qualified for use in the nuclear environment would be of high priority. Also look at existing gaps in sensing technologies to see what you think would be high priority.

Are applications on wireless sensors encouraged?

Yes.

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

2018 CINR Workscope Specific Q&A

What is meant by training being of interest on slide 2?

In the course of pursuing this modeling and simulation goal, think about how you would use the work you are doing to teach the next generation of students. Also interested in using modeling and simulation for training the operators as well.

Are there any additional workforce training activities that are acceptable to the scope?

Yes, really looking for modeling and simulation tools and as a secondary benefit they should be able to be used to train operators and designers.

Are you interested in other cybersecurity methods and tools that have found other applications like the power grid?

Yes.

Is the topic more on control or could there also be system testing?

Experiments are definitely part of this. You need to build your model and verify and validate it against actual performance systems.

For NE-1 can the modeling and simulation apply to non-reactor nuclear facilities i.e. enrichment or fuel fabrication facilities?

Yes, anywhere in the nuclear enterprise, could be for research reactors, fuel fab, waste disposal, etc.

Can you elaborate more on the risk management portion of the scope?

The purpose of the M&S capability is so folks can understand the risk and management. You can't really manage your risk if you don't know what it is and if you don't have the tools to assess it.

Is there a way to submit a proposal so it would test the cybersecurity of an existing nuclear plant?

It's a M&S problem, if your proposal is to model and simulate a particular feature of a particular plant and then test it, you should test it through simulation, not in a live plant.

NE-2: Hybrid Energy Systems Design and Modeling:

Under the area of tools for RAVEN and Modelica, are models of commercially available energy storage technologies only of interest or are lab staged technologies also relevant here?

Lab staged technologies are relevant as well as long as they are pertinent and applicable to something that could be found in the real world. If something is a new system that has not been tried before, that would fall under the second area of interest of demonstrating low TRL activities.

Are there specific sub components of hybrid systems for which models are sought?

Not at this time, really looking for something innovative that could come from the universities. Currently a generic reactor model has been done, the models of existing or renewable energy systems from wind and solar have been done. On the energy storage and production side, models have been done of solid oxide electrolizer have been done. Besides those, there are many opportunities for other things to be done.

The call mentions thermal storage, is there other methods of storage that are of interest?

At this time, only thermal storage is of highest interest.

Is there an available list of existing component models that are already integrated into RAVEN and Modelica?

If you send contact information to us, we can get that information from the researcher at INL for you.

Are distributed renewable energy systems, i.e. rooftop solar, of interest?

Not so much, mostly looking at large scale renewable energy systems.

Are dynamic models for the evolution of renewables with nuclear capacity of interest?

Yes and they should be compatible with work already being done with RAVEN and Modelica.

Are partnerships with industry or national labs required?

No, not required.

Is there more information available for DETAIL (Dynamic Energy Transport Integration Laboratory)? Is this an existing experimental capability at INL?

The DETAIL lab is still being assembled at INL and there is information available as to what will go into it when it's actually constructed**.** It is a small-scale dynamic loop that includes battery testing for electrical real-time simulation of renewable energy sources and a thermal loop simulating a reactor and reactor response.

2018 CINR Workscope Specific Q&A

Is system safety analysis of interest in the modeling and simulation part of the scope?

I can't say for sure and would have to see what is proposed and have it considered; it is not specifically in the call though.

Is there additional incentive for evaluating options that have potential international collaboration?

No additional incentive.

How many awards are expected in this area?

Likely just one award.

Is the operational safety analysis for the load-following mode for the N-R HES of interest?

Yes, in terms of how energy stored systems or specific components are used to be modeled.

Is operation and control strategies development of interest?

No.

Are improved reactor dynamic models of interest in the modeling call?

Yes.

Are battery systems of interest?

A fair amount of battery work is already being done. But a new battery system could be of interest.

Clarification on international clarification question:

There is additional consideration being given under the relevancy review in pre- and full applications on industry international minority serving institution or underrepresented group collaborations. Outlined in last year's FOA if you are not familiar with the points/structure given. Essentially any non-traditional partnership is encouraged.

Several component models have been developed in Modelica under the N-R HES Program. These include:

- Nuclear steam supply system (primary heat generator) based on an integral PWR, 1000 MWt
- Thermal energy manifold
- Switchyard
- Balance of plant (power conversion system)
- Electrical storage system (battery) - initial model
- Industrial processes integrated within HES:
  --> Reverse osmosis desalination plant
  --> Gas turbine power plant
  --> High-temperature steam electrolysis plant

Additional mathematical models have been started for chilled water storage, sensible heat thermal energy storage, steam accumulators, and compressed air storage via a university partner; it is anticipated that some of these models will be converted to Modelica in the next year, such that they can be integrated into the broader HES M&S work.
Please contact Shannon Bragg-Sitton (shannon.bragg-sitton@inl.gov) should you need further detail.