

## **FY 2016 Webinar Specific Question & Answer**

### **Consolidated Innovative Nuclear Research FOA Overview**

#### **When are MS-EM-1 pre-applications due?**

On that workscope, and that workscope only on Appendix A, a pre-application is not required and should not be submitted. In working with the Japanese government with the number of applications under that are being limited and helping meet the needs of the Japanese government on their funding and making funding available to their collaborators we have decided it is in the best interest of both governments to not have a pre-application under that workscope.

#### **Is pairing with a Japanese utility permitted with MS-EM-1?**

We will have to confirm/consult with the Japanese government. As of now we believe that partnering or collaborating with a Japanese utility is not allowed. We believe the focus is to target collaborations with Japanese universities or research entities.

#### **If you are a PI on an NEUP project that concludes in January of 2017, would that count towards the eligibility?**

Yes, your project must conclude by December 31, 2016. You could accelerate the end of that project and get it done in December. That is up to you and we can negotiate that.

#### **Considering how important Instrumentation and Controls are, what opportunities are available in the instrumentation and controls area?**

We tend to integrate all of our technologies together. There are a few including RC-5 Information, Instrumentation, and Controls by Rich Reister and Bruce Hallbert that talks about sensors and passive signals. Another area concerning I&C is NE-1 which is Nuclear Energy Cybersecurity Implications and Control Room Operations and at least one IRP on robotics sponsored by EM that has a lot of sensors and instrumentation issues associated with that IRP. There are many other opportunities as well.

#### **Do we need authorization letters from international collaborators?**

No, we do not need authorization letters from international collaborators.

#### **What is the deadline for Full Applications?**

The deadline is February 18, 2016 at 8:00 PM ET.

**Is the UK collaboration still available this year or is the Japanese collaborations in MS-EM-1 the main international collaboration opportunity?**

We are in discussion with the representatives of the United Kingdom and they are evaluating the worksopes in their draft form. They will be getting back to us as soon as possible to what extent, if at all, they will be able to collaborate. I know they very much wish to, but whether or not they will be able to will depend on the nature of the worksopes this year and how they sync up with the UK's needs and their funding limitations for the next fiscal year. Stand by on that and we will communicate opportunities through neup.gov and other communication methods.

**Is MS-EM-1 the only workscope where we can collaborate with the Japanese or are their other areas where we can have these collaborations?**

You are certainly welcome to collaborate with the Japanese in any portion of the FOA however, funding is only available through the Japanese government on the MS-EM-1 workscope.

**Who can be a PI? Can research faculty or postdocs be PIs or is it only tenure-track faculty?**

The answer is yes. That is determined by your own institution. If it is okay with your institution and they are standing behind you as the PI then we will accept you as a PI. It is not required that you are a tenure or tenure-track faculty member to be a PI for DOE.

**Are facilities outside of the National Science User Facilities family are recognized as appropriate institutions for NSUF support?**

No, only institutions listed as NSUF facilities in the FOA are eligible for NSUF funding. We would like to add that in the future other facilities could become part of that NSUF family by applying for that, but if it is not listed right now it will not be considered.

**What opportunities address dry cask storage?**

I believe we have an IRP that is considering misloading. There may be nuances of dry cask work in other worksopes if you read through them. There is an area, IRP-FC-2 that address dry cask misloading evaluation techniques and transportation issues in R&D this time and there may be other parts of worksopes that considering monitoring, sensing, etc.

**Does a PI have to have a minimum of 10 publications to apply?**

No, we do not have a threshold concerning how many publications a PI must have to apply. The requirement for being a PI is determined by a university. The more

publications you have in a relevant area will help you get a better score in the sense of having the proper background for doing the work. There is no minimum requirement though on publications for submitting a proposal.

**Can a PI hire a non-U.S. citizen graduate student?**

The student may be funded if they are academically enrolled in a U.S. academic institution, however, funding cannot be sent to an international institution in which that student is a citizen. The only requirement is on U.S. citizenship is on the Scholarship & Fellowship program if funded by Congress. For support of students on research projects, foreign students are allowed if they are properly supervised and abide by all export laws, etc.

**Do you have any statistical data about last year's success rate of full applications?**

Yes, we do have the data. It is about 25% success rate for the standard NEUP R&D full applications submitted, so that was consistent with past years of around 20-25%. That number includes applications that were uninvited but were submitted anyway. So submitted a full proposal has a much higher probability of success than NSF at about 20-25%. But that is not a guaranteed number, nor is it a quota, or anything like that. The success rate has just typically be on that order.

**Can the PI miss submitting the Letter of Intent but still submit a pre-application?**

The only area where a Letter of Intent is necessary is for the NSUF. If you are planning on submitting to a NSUF workscope you must submit a Letter of Intent.

**What opportunities address Probabilistic Risk Assessment (PRA)?**

It is your responsibility to read the FOA and the appended worksopes, and I do not have those worksopes in front of me to identify where PRA may be applicable. It does come to mind that there is a Risk-Informed Safety Margin workscope that would involve PRA of some sort. You would have to look at the individual worksopes to see how that might be integrated into any of the analysis.

**Is there a specific workscope to cover the long-term surface storage of waste?**

The answer to all questions about worksopes is it is your responsibility to read through all the worksopes. There may be several workscope areas that will be applicable to your technical area of expertise.

**Are the NEET-NSUF worksopes the only areas that fall under NSUF or are their other workscope areas that apply to NSUF too?**

The NSUF workscopes are in Appendix B. Those are the only workscopes where we have NSUF applications that may either request R&D support or only access. To clarify, no other workscopes are available to use NSUF. If the PI wishes to receive funding from the NSUF program the only way that is going to happen through this solicitation is if your proposal requests funding through the NSUF-NEET-1 and NSUF-NEET-2 workscope areas in Appendix B. In any workscope if you are to outline how you would access or use a facility that is in the NSUF suite of capabilities that is fine, it is just that you would have to explain in your application how you were going to obtain access. For example, if you are an MIT research and you intend to use the MIT reactor and you will use your own internal capabilities or R&D funds to gain access to the reactor that is fine. NSUF-NEET-1 & 2 are the means by which major NSUF awards: irradiation, PIE, irradiation & PIE combination, beamline are going to be made.

### **Under NSUF can graduate students be supported at the university?**

Under NSUF-NEET-1, if you need research funding to support a graduate student you would find it there. There are workscopes in NSUF-NEET-1 that will be funded and sponsored by the reactor concepts program, the fuel cycle program, and the crosscutting research program. So as you will see in the FOA, you can receive R&D funds if you are successful under NSUF-1. Those funds can be used like other R&D funds to support graduate students. The NSUF funds that will be provided, not to the university, but to fund access to NSUF capabilities, are not authorized to be used to fund the supporting graduate students.

This year there are in fact dollars specifically for NSUF R&D. This was available last year but we are trying to make it even more accessible to allow support of graduate students and others to stimulate use of NSUF.

### **Will the eligibility limit of three maximum cooperative agreements as of December 31, 2016 strictly for DOE R&D projects or for any federally funded R&D project?**

That is intended for DOE-NE R&D projects. It does not include NSF, DoD, or other grants.

## **Consolidated Scientific Infrastructure FOA Overview**

### **Do proposed computing clusters qualify for GSI funding?**

They may qualify for GSI funding per the FOA. We have had those types of applications in the past and they certainly must have an educational component or more importantly, a direct supporting function for R&D.

**Can industry-owned facilities be incorporated into the national laboratory submissions?**

I'm not understanding if you would purchase equipment to replace something at an industry location or if it is augmenting capabilities at a certain location.

**Can university proposals include annual service contracts?**

No, they cannot.

**Is there a cut-off date for eligibility based on no-cost extensions like the R&D projects have?**

No, those are evaluated on a case-by-case basis. We understand that these are sometimes procurement issues that the PI cannot control. So if you currently have a no-cost time extension then you will need to contact us to see if you are eligible to participate.

**Could you explain the logic behind the \$250,000 GSI limit?**

You have an award ceiling of \$2M but you have to cost match after \$250,000. So if you had a piece of equipment that cost \$300,000 you would have to cost match \$25,000 in addition to your request to have the federal government match that portion of the project. There are examples of this in the FOA and additional information.

**Is a university linear accelerator eligible for GSI?**

It would be eligible for augmentation in terms of GSI.

**Nuclear Science User Facilities Overview**

**Is the Letter of Intent required for both NEET-NSUF-1 & 2?**

Yes, the Letter of Intent is required for both worksopes since both are requesting NSUF access.

**Can any university that is not listed as a partner be granted NSUF access?**

Any university can apply for access, whether they are a partner or not, through this process.

**Are fundamental studies limited to structural materials?**

No, I would expect that fundamental studies would be available in any of the sub-workscopes.

**Do I have to go through NSUF to gain access to any available beamline at the Advanced Photon Source?**

The MRCAT beamline referenced here is the NSUF partner beamline. You are certainly welcome to apply through the Office of Science to the APS, it's a user facility of its own, but that would be through a different process.

**Do NSUF proposals have to be coupled with a R&D proposal or could it be coupled with a project funded last year?**

If that were the case you wouldn't couple it, you would apply through NSUF-NEET-2 which is the Access Only, which means you already have your R&D funding, now you just need NSUF access.

**Can the same PI submit the same proposal to NEET-NSUF-1.2a and FC-2.1?**

We would prefer that you do not do that. If you were to do that you would have to specify and delineate how you would need and use NSUF capabilities in this call. If you do not need NSUF capabilities you could apply to FC-2.1.

**What separate effects are the modeling group looking for ATF or LWRs?**

This is Frank Goldner. That topic will be covered in the FC-2 area discussion.

**So workscope areas that are not NEET are not eligible for NSUF access?**

Any proposal requesting NSUF access has to work through the NEET-NSUF 1 & 2 workscopes. The funding that is behind those may come from, for example, Fuel Cycle, but all applications have to come through those workscopes.

**On the weld repairs is this to examine an existing technique or developing a new technique?**

The welding technique is already under development by primarily EPRI with support by Oak Ridge National Laboratory. There is a welding facility that is under construction now that will be placed in a hot cell at Oak Ridge this fall and that weld repair technology, friction stir welding primarily, will be welding both un-irradiated materials and irradiated materials. So it will be an examination of re-irradiation of those materials to validate the performance of the materials after they are repaired using a technology under development by EPRI. This is just an examination of the prior and post repair of those welds.

**Can you specify the fuel type for NEET-NSUF-1.1e?**

It's a coated graphite composite that is formed from the NERVA technology from the 1960s.

**You mentioned the presence of H<sub>2</sub>. What is the coolant in which this fuel operates, and why is it exposed to H<sub>2</sub>?**

So, for a Nuclear Thermal Propulsion System, liquid hydrogen is used to cool the rocket engine nozzle. Once it does this job, the hydrogen goes through the nuclear reactor to cool the reactor fuel. After the hydrogen has taken on this nuclear heat, its volume is allowed to expand (vaporizes) and pushes against the rocket nozzle to drive the rocket forward.

Hydrogen is used because smaller individual particle mass improves the performance of the propellant. Stated a different way, specific impulse increases with exhaust velocity, and the exhaust velocity goes up as the particle mass goes down.

So, it is the hydrogen that is flowing through the coolant channels of the nuclear fuel.

**Are shielding materials testing within the scope?**

No. Shielding works fine but we are interested in fission product transport within gas cooled systems and within sodium systems. Shielding walls and things like that, the fission products would typically plate out inside of containment. So you could postulate that but please look at the Argonne report. We also have information for what we are looking for the diffusion and nuclide transport for the gas-cooled systems as well. Fission products don't typically go through shielding they just plate on and hopefully they don't diffuse because the walls are painted with a special paint.

Do you prefer relatively small short experiments or do you prefer an integrated experimental plan containing various levels of experimentation?

We would like to have an experimental plan. Of course, the whole idea of having the NEUP plus the NSUF was to allow universities to have up to 7 years to establish an integrated plan. If you wanted simple experiments for a shorter duration that is fine, or if you want to target that, but funding would have to be done appropriately. You could propose one, but we would like for the applicants to look at a couple of isotopes.

**Is the study of fission product diffusion in the matrix graphite material for gas-cooled reactor fuel element part of the scope?**

Yes, it is. Let me give you an example. You could take some matrix graphite, just graphite blocks themselves. We have those un-irradiated. You could paint one side with non-radioactive silver and do a heat up test at the university. We also have irradiated matrix material that was irradiated in the advanced graphite creep test so we have matrixed material specimens as well as structural graphite that we have as archived material. Then you could test that individually. As to having fuel particles, we don't tend to hand them out, but we do have loose fuel particles and integral compacts at Idaho and Oak Ridge that are available to our applicants.

Would you be interested in molecular modeling fission product diffusion results?

If they are used to support the experimental data. The issue is to use that sort of modeling to derive the diffusion constants from the experiments and then validate it with molecular diffusion models. Think about using both.

**Could you remind us where the ANL report is from and where it can be accessed on the web?**

You can do this two ways. You can go to the OSTI Bridge, and the title is, "Regulatory Technology Development Plan: Sodium Fast Reactor. Mechanistic source term development." The first author is David Grabaskas. I'm sure if you search on Grabaskas you will be able to find it. It is also available with the Advanced Reactor Technologies at Argonne National Laboratory. I pulled this down from the OSTI direct system yesterday. We may put it up on the NEUP.gov if it is possible with the NEUP team. It's chunky, it's 150 pages but I want you to concentrate on it so you don't propose what has already been done and solved. It is the gap analysis that is of interest.

**Are all of the facilities open for use by university applicants? What kind of security checks or authorizations are required?**

If you were to use CAES at Idaho that is 'outside the fence' so generally there is foreign access allowed. If a student were not a U.S. citizen we would have to go through the standard protocol at Idaho National Laboratory, Oak Ridge, or Argonne. You would be set up with a specific laboratory supervisor so we would go through that and, of course, we would like to have as many students come and work there. So this would be done on a case-by-case basis and we are not restricting it to U.S. citizens only, but we will follow the security protocols at each lab.

**Could you give an example of when fission product diffusion rates are needed?**

Yes, especially diffusion and sorption in the graphite blocks in the prismatic design, the is also graphite only in the pebble bed fuel. So there is fuel that is packed in a sphere and then graphite only regions where we would like to have that information. We have some SEM and TEM diffusion actual isotopes available from CAES and from the Idaho team with Dr. Van Rooyen, so we do have some SEM and



TEM available for that. What we could do is if there was specific need to do a drop-in test at the Advanced Test Reactor we do have some archive material that could be irradiated for a short time. The graphite matrix, the graphite structural is extremely important. We would also want to have diffusion and fission product plating and lift-off in the sodium loops, and the diffusion within stagnate but heated sodium pools as well because there is diffusion through the sodium. Yes, you can do a sodium fire event but please do it, if you want to do it small scale at the university is okay, but we do have facilities to do sodium burn cells at Argonne. So we don't want any graduate students hurt in the process.

## **FC-1 Overview**

### **Could clarify the surrogate testing?**

For example, I want to do a test. I can use an actinide, I can use Europium for example, at the university. But when we focus on Americium-3 or Americium-6, whatever test you complete at the university I need you to complete another test at a national lab. We need to have data with the real thing, which is Americium, so that is the surrogate. You can do a surrogate test at the university but don't forget to put in your proposal that you will repeat it with the real thing at a national laboratory.

### **Are you only interested in existing paradigms for separations?**

No, we would love to have ideas from the university community for alternatives to the existing paradigm. There are possibilities involving use of volatility methods, or possibilities using inorganic ion exchange, there are a number of alternative and we would be delighted to have recommendations from the university community.

### **Can you speak more to the problems with sodalite glass waste forms?**

We can ask John Vienna during the IRP discussion.

## **FC-2 Overview**

### **Is characterization of HT-9 at dpa 200 an area of interest?**

Yes, that is an area of interest but we are looking to challenge that a bit and go to higher dpas so 200 or higher would be of interest. We actually made the challenge to go to 300-400 dpas a few years back. That is a grand challenge that is still in the program.

### **How is FC-2.2 on metallic transmutation fuel different from MS-FC-1?**

MS-FC-1 is for 'blue-sky' proposals for all of Fuel Cycle. It includes transmutation, materials and waste forms, etc. This workscope is only focused on transmutation fuels for fast reactors and transmutation fuels being considered by the program. The MS-FC-1 could be more broad.

**What are the reasons behind priority of metallic fuel over ceramic fuel?**

It's kind of a historic things, we don't have enough money to do full blown programs on all the fuels. Metallic and ceramic fuels are both in the program, but if you notice almost the whole world is moving forward on ceramic fuels in the transmutation fuel area. So a few years ago we would make a higher priority for metal fuel development because we think it has some very promising benefits that would almost make it a fuel of choice if the R&D were successful.

**FC-3 Overview**

**Is new sensor development in the scope?**

No, this year we are taking a much smaller scope and this year we are not looking for sensors. It is likely in future years that we will take a smaller part of the campaign itself and we will alternate. So maybe one year may be neutron detectors, next year maybe gamma detectors. This particular year we are looking for ways to integrate data.

**Would new x-ray computed tomography methods for material accounting be of interest or are you only interested in integration of existing methods?**

Certainly if the x-ray tomography were to add an additional layer of data that could be used to verify data that already exist of the type as a complement to that. But alone it would not be of interest. How it could be used to verify other measurement or compliment other data would be of interest.

**How does this workscope relate to the NNSA's NGSF Spent Fuel NDA projects?**

NGSI spent fuel projects have a lot more to do with verification of declared nuclear material and most of that is in unit form meaning an assembly. Although it is difficult to ascertain the actual fissile content, they are looking at an assembly at a time. We are more concerned with what is often time a more difficult problem, which is bulk material. The NGSF program is also focused on an international safeguards focus whereas we are looking at meeting domestic NRC regulations.

**Are you looking for data analysis methods for online monitoring of facility operations?**

Yes.

**For reducing SEID, are you looking for NDA data on fuel assemblies prior to reprocessing or only DA data after chopping and dissolving fuel?**

WE are looking for both as long as they are reducing SEID by being treated comprehensively.

## **FC-4 & IRP-FC-2 Overview**

**Is surface storage included?**

No, we are looking at disposal in a geologic media. There is the requirement that retrievability be maintained. The underground storage term is used, but we still need retrievability.

**Are you looking for fundamental studies or only studies that fold into existing repository models?**

We are looking for fundamental studies. The repository models that we have are the strongest in a welded tuff and there is lesser strength in other geologic media such as clays and granite. We are interested in basic studies.

**Are new materials or manufacturing methods for LWR cladding that mitigate or eliminate hydride formation and DHC within the scope of FC-4 or IRP-FC-2?**

It would be in how the materials would react in a repository reducing environment and how it would be a part of the engineered barrier materials and would react under differing chemical, thermal, and hydro situations. How it would react in a wet environment with different chemical and temperature conditions. In that perspective it would be yes. In manufacturing, no it would not. Just in how the material itself would react and perform in a repository environment.

**Could you provide clarification on 'research conducted to date'. Is that university research or DOE conducted research?**

The answer is yes to both questions. It would be DOE conducted research that is available in the LSN system and also university research that has been done to date.

**Are deep boreholes included in the scope?**

Yes.

**Must engineered barriers be considered for proposed studies?**

The spent nuclear fuel will be placed underground as part of an engineered barrier. The intent is to find out how the disposal components will perform from a comprehensive perspective. We use the term engineered barrier in that there might be, for talking purposes, that there material placed around the package itself and we would want to know in an elevated temperature environment and under different conditions of moisture and chemical processes, how all the interactive components would preform over time.

**Can the safety analysis guide for Yucca Mountain can be used for this proposal?**

The safety analysis guide would be a useful source document for a proposal.

**Are you interest in measuring the heat reactivity, initial enrichment burn-up, and cooling time of individual assemblies?**

All of those parameters would be part of the picture. They would be data points that would involve the performance of the waste package and the surrounding engineered barrier, so all of those would be key inputs to the total system performance. The short answer is yes, in how they affect the waste and engineered barrier in the underground environment.

**Is there a specific location for previous university research or are you referring to previously funded FC-4 projects?**

We are referring to NEUP funded projects as well as prior research done on the License Support Network (LSN).

**Would the development of dry cask storage systems be part of this scope?**

The development of dry cask storage systems is outside of the scope. It is a surface storage consideration and we are looking at underground, geologic placement.

**Most proposed studies consider full system performance. Can a sub-system be studied i.e. radionuclide transport post barriers?**

Yes, that would be a focus area within the total system but we would consider it.

**Would an active IRP be limiting for an applicant?**

An active IRP where the PI is the lead is restrictive. If you are a Co-PI or collaborating PI would not be restrictive for additional R&D funding or an IRP.

**Is the object of the study the cask, or the canister, or both?**

The object of the study is to get a peek at the internals. Primarily we want to find out the condition of the assemblies and the rack that holds the assemblies to find out if in effect they have been jarred or loosened or bowed or to what degree they have sustained damage, if any. Then we would have the intent of cataloguing and isolating a canister with damaged internals. The focus is to peek through innovative technologies of the internals.

**Last year we were asked to contact utilities for onsite testing of dry casks. Is this still required in this IRP?**

That would be useful and considered in the application.

**Is a collaboration with a cask company required?**

No, but would be a part of the proposal and a plus in the consideration and evaluation of the proposal.

**You mentioned that they should be non-invasive, how close to the fuel can we get?**

The canister walls are as close as you could get because we do not want to breach the canisters, and that would be as close as you can get. Now these canisters will be in transportation overpacks so if there is a way to get under the overpacks to the wall of the canister, which would be a plus. But we would like an innovative technique to be able to get as close as we can to the canister wall to take a peek inside without breaching the canister.

**Will the mock-up be a 1:1 size or can it be scaled down for lab testing?**

The size of the mock-up that can be subject to the capabilities of the PI, and that would be part of the consideration. The larger the mock-up the more accurate or relevant would be the results. That would be at the discretion of the PI.

**Is determining fuel burn-up a requirement?**

There will be differing levels of fuel burn-up in the canisters. That information should be a part of the existing information on individual canisters, but if there is a methodology that could determine or verify that level of burn-up that would be considered a plus.

**FC-5 Overview**

**Is there interest in analyses of nuclear generation coupled with grid scale energy storage technologies to maximize revenue?**

The topic is on visualization so if you could do that topic with the visualization in it I think it would be of interest. If it is something that is outside the call the MS-FC-1 area is for areas outside of the specific program scopes.

**MS-FC-1 Overview**

**Does improving MOX fuel utilization in LWRs fit in this scope?**

I think this fits in this scope because it is not captured elsewhere.

**Would advanced fuel such as inert matrix fuels be of interest to this workscope or the program?**

I think they could along the same lines. But please look at the program specific calls and the NEET-NSUF. In areas related to that we have some specific gaps we are trying to fill so I would point you toward that. It would be fair game.

**If someone submits a pre-application in this workscope area but it is more suitable in a program supporting area will the program managers move the proposal?**

There is difficulty in moving proposals between workscope areas especially when there are differences in budgets/money for the workscope. It is your responsibility to choose the correct workscope area. You have the ability to interact with the program managers and the TPOCs up to the point of pre-application submission to clarify any questions you may have.

**RC-1 Overview**

**Do you support pebble bed reactor experiments?**

Not exclusively. If your proposal deals with an exclusive pebble bed reactor feature, such as flow of pebbles, it doesn't get ruled out but it gets rather low priority. The prismatic reactor is the preferred option at this point. Nevertheless, if you have an experiment that supports both, like bypass flow air ingress or water ingress, that is of interest to both concepts while fulfilling the requirements here it would be accepted. In fact, as long as it is equally applicable to both pebble beds are fine, and in fact it may even be more desirable given that there are pebble bed reactors operating and even being considered for deployment in the U.S.

The priority is for prismatic reactors.

**Do proposals have to have to include one of the ANL, OSU, or INL facilities?**

No. We do give a nod toward existing facilities that have been built at the labs or at the universities so if you want to partner with a university that already had an experiment and put some additional instrumentation or perform a different set of experiments then that is viewed favorably.

**Is DOE interested in experiments performed at foreign facilities such a the HTTR in Japan?**

A few foreign facilities, for example, the HTTR in which the DOE has a bilateral agreement to pursue joint HTR technology development and in fact, we are looking at using HTTR as a test bed for new high temperature reactor instrumentation. If you have an experiment or measuring device or technique that is best tested at an existing reactor facility I would go so far to say that the Japan Atomic Energy Agency would welcome discussion on that and we would be happy to broker that. We are currently in a series of tests and experiments with JAEA that are joint tasks that would involve some of their facilities, that reactor specifically, and some NEUP funded facilities like the HTTF.

Now other ones, like an experiment at an institution in Eastern Europe, for example, it is a little more difficult because we may not have an agreement so we may not be able to interact with that country and the facility and experiments would have to go through some type of qualification, NQA-1 qualification so that the data would be useful to us. So it is very much specific to the country and institution that is being suggested.

**Should all experiments be at integral scale?**

No, fundamental, separate effects, and if you look at what we have done in the past part of the NGNP program, which is now the ART HTR Program, we have a validation pyramid which implies a large number of separate effects and fundamental effect and a fewer number of mixed effects experiments, and integral effects are just a few at the top of the pyramid. For example, we have conducted isothermal CFD experiments at the INL with bypass flow, the next logical step would be heated non-isothermal experiments to capture that effect and there is plenty of room for that level of data.

**If the university is interested in performing experimental activities that follows industry standards and QA programs but may not 100% conform to NQA-1 requirements, would this impact the success of the proposal?**

We would have to evaluate that individually. The arrangement with the universities with the NEUP program is that we do not have a hammer that we can hold over and say 'thou shalt follow NQA-1'. In our opinion, it makes it much more desirable in that the data you generate will live far beyond the journal that is published on the

experiment but that it will be included in the broader database of experiments in data that can be used for validation and code qualification and so on, by whatever the vendor NRC settles on. We do favor a good quality program and the INL stands ready to set up such an effort at the university. If you are following a QA program that is followed by industry we would take that into consideration.

**Do you have any requirements of what codes the proposal should use for preparing the experiments?**

None. The objective of the RC-1 call is to provide data that can be used generically by whomever is developing a code or using a code. That could be a system code, CFD, high fidelity multi-physics for example. Certainly, some types of data and experiments are better suited to different types of codes and their capabilities, but we don't look for specific code analysis.

**How much of the V&V components will we need in addition to performing experiments? Is it just experimental data or to provide something more?**

The minimum requirement is to provide experimental data. If you can demonstrate that you are validating a model of your experiment with this then that is viewed favorable, we encourage that. Code validation with existing data is given lower priority.

**Is there a list of other facilities not mentioned in the presentation that are available to universities?**

Unfortunately not, you can do some searching if you have access to publications from previous NEUP performers, for example, an interesting facility that was built at City College of New York by Professor Kawaji that may be available by talking to him. But do we have a list of facilities around the country that could be used? I wish we did, but we do not. And it is questionable whether or not we could publish it if it were not a DOE facility.

**For air and water ingress, what specific phenomena and related data do you need?**

That varies. Particularly with air ingress the issue there is with oxidation of graphite structures. We have done some very fundamental experiments in air ingress with two fluids of different densities to validate our models of how quickly you get an exchange between the helium in the primary system and the surrounding reactor building. And we have some separate experimental data on the oxidation of graphite under various conditions. What we don't have yet and what we hope to get with the Oregon State HTTF is a combination of air ingress and graphite oxidation. We will have graphite coupons dispersed throughout that core and facility so we can see both. That dataset won't be complete and we encourage those types of experiments that couple the air ingress phenomena with graphite oxidation.



On the water ingress side is also the effect of fission product transport. Will it wash off or otherwise extract fission products from the graphite core matrix that being water/chemical interactions? Will it generate through chemical reactions with the graphite carbon dioxide, which would create a flame hazard, that sort of thing. So now we are drifting into the materials area, but that is where the interesting things happen with these severe accidents in high temperature reactors. You get these interactions with the core materials that may or may not be degrading to them.

### **Is data from NCSHRT at Argonne available to the public?**

It will be since it was funded by DOE. Some of the data is not so we may have to go through some sort of an export control process to get it released but it is data that is generally accessible as part of the HTR program.

## **RC-2 Overview**

### **Are alternate manufacturing methods for making micro-channel heat exchangers of interest in RC-2.1?**

The thrust of the proposed work is to provide a basis for developing ASME code rules. I think that the principle goal is not innovative ways to manufacture heat exchangers but by looking at the methods that are widely used and relatively mature to understand how to do other required stress analyses and develop the basis for the rules for ASME. Not that we wouldn't consider that but it is not the priority. Tom Sowinski presented the MS-RC-1 area, which are for game changers in the category rather than the specifics that we covered today.

### **Would non-destructive inspection or condition monitoring of compact heat exchangers be of interest in RC-2.1?**

Absolutely, one of the basis for concern in developing code rules is how would compact heat exchangers be monitored and evaluated pre-service and in-service because the current rules cannot be followed for the geometries that are inherent in compact heat exchangers. That would be of high interest.

### **Are new testing techniques or equipment for testing for RC-2.3 also relevant?**

As long as they illustrate the effect of helium tribology on the types of materials in the environments we are looking at, then yes.

### **Development of new structural materials with better performance than the existing alloys are not of interest in this area RC-2.1 and RC-2.3?**

Those are both well beyond the scope of those particular worksopes that are fairly closely targeted so no.

### **RC-3 Overview**

**Are there any plans to formalize this data into an OECD or OECD-like benchmark?**

At this point I don't believe this will be used toward the benchmark at this time, but it could lead to future work for validating these zero-dimensional codes that could play into that future goal.

**Is graphite performance also considered?**

This year we are focusing on sodium fast reactor methodologies so graphite does not generally fall into the purview of sodium fast reactors.

**Is there any preferences of the software that will be used, for example MOOSE vs. COMSOL?**

I know we are generally trying to utilize our own in-house software, which is based off of the SAS-4a and SAS-S1 code suites. Based on those two options I would say MOOSE is the closer of the two but we are looking for more enhancement on the code suites currently mentioned in this presentation.

**Is thermostructural analysis containment including aging and deterioration of concrete shielding of interest?**

That could be an area of interest in terms of containment degradation, so yes.

**There is interest in experimental verification of the heat transfer code?**

Yes, that is correct.

**Slide 4 shows the air-cool RCCS facility at ANL. Can you please clarify the connection of these facilities with the scope in RC-3?**

Sure, that particular facility showed experimental work that I did not provide specific examples for. That is to show that for both fast reactors and for high temperature reactors that facility is used to show possible decay heat removal paths and their effects.

**Would access to SAS be available?**

That I would have to engage with the technical point of contact to find out. There may be the ability to access a source code application to use but I will have to dig a little deeper on that question on a case-by-case basis. The actual level or version of that code that you would get access to I would need to discuss with the technical point of contact.

**Do neutronics have to connect to the stratification issue?**

Not necessarily, but what would be beneficial is that we are trying to use these lower order stratification models for a systems integration analysis. So merging that with neutronics would go hand-in-hand so it would be beneficial.

**For new software, is it of interest to develop new materials models for extreme environments?**

Just talking about the previous questions referring to materials degradation in terms of containment of accident response, that would be beneficial to be included, from that angle.

**Are you interested in data with high Prandtl number fluids, such as water?**

No, we are looking for low Prandtl number fluids in the liquid metal regimes.

**Can other metals in place of sodium be used?**

For this particular scope we sodium is a priority. The primary focus of our R&D program is sodium, though other metals may be considered if they have similar properties to sodium.

**RC-4 Overview**

**For the creep crack interaction for concrete should we use GRIZZLY or can we use our own code?**

I would say either one is acceptable. We would probably prefer something with the GRIZZLY code but if there were another code that could be applicable that would be fine.

**Do we include hot cell charges when looking at irradiation effects on toughness for RC-4 or is this a NSUF topic?**

Well if you wanted to use radiation facilities I would recommend doing it through a NSUF proposal. I'm not really sure about the NSUF vs. NEUP and how that interaction works. So the NSUF access work by only propose a R&D joint with NSUF access proposal in the NEET-NSUF-1 area and Rich did present earlier on three

areas related to LWRS in NEET-NSUF-1 that are eligible for NSUF access with R&D support.

**Would proposals solely focused on computational modeling of materials degradation under irradiation be considered?**

That would be okay. I would at least like to see a validation plan tie into some databases. This mechanism has been studied rather extensively by the Department of Transportation but not for nuclear applications or nuclear structures so there might not be any experiments required. I would like to see some sort of validation approach to back up that model.

**Is cladding included in the scope of RC-4?**

No.

**If an industry partner develops code does it have to be finally owned by DOE or can a research collaborative agreement be made?**

A CRADA may be used in that instance. That is generally an agreement with the federal government. So if your university has a similar type of agreement that recognizes developed intellectual property that would be the appropriate instrument to be used.

**Are any of the samples for study on the effect of irradiation on fracture thoroughness, creep, or SCC be provided to the PIs?**

I think that would depend on what they were proposing. Through the NSUF there is a rather extensive library of preexisting specimens that could be capped at very little cost compared to irradiating and transporting them from scratch. I think that would depend a lot on the specific conditions that the proposer was looking for. It may take a little detective work.

**RC-5 Overview**

**RC-5 has two parts. The first is flow assisted corrosion. Are we supposed to work with INL for that?**

Well, you certainly don't have to work with INL for that. The test rig and sensor network at INL would be available if you want to use it.

**Is RC-5 only for alkali-silica reactions or are other degradation mechanisms applicable as well?**

Other mechanisms are possible although there was a desire to have alkali-silica reactions in concrete and well as flow assisted corrosion are considered more desirable.

**Do we need to address both topics in the proposal?**

No, you can have one or the other.

**Are you also interested in new NBT or sensing technologies or only in signal processing methods?**

Principally in signal processing methods but if there is a signal processing method that could be coupled with a new type of sensor then we would also be interested in that.

### **RC-6 Overview**

**In the workscope it is mentioned to use RELAP-7 for SBO transients. Is this the only code that can be used?**

No, other codes can be used. We would prefer to use RELAP-7 because it is the RISMIC MOOSE-based codes and we are trying to integrate some of these code techniques with the RISMIC program. This type of analysis has been done with RELAP-5, for example. In our view it is a lot harder to do with the legacy codes than with the new codes, and we are trying to move forward with the new codes.

**Is familiarizing yourself with RISMIC codes a prerequisite to apply?**

No you do not need a detailed knowledge. Our desire is to get more people familiar with these codes, so that is part of the process. We want people to start exercising these codes so that's our process.

### **RC-7 Overview**

**Would improving RELAP-7 modeling be part of the workscope?**

Certainly if there was a part of the validation process between the data and the code, answering why there is an inconsistency. That might lead to improvement in the model or the underlying models that are used in RELAP-7 code. Some of those improvements could be suggested as part of that process. The answer is yes, it would be.

**Is there interest in development of new statistical validation tools?**

If it were to RELAP-7 then that would be okay. If it is non-traditional novel things that may be better suited for the IRP call, but it would depend on the details of the proposal.

**When will a RELAP-7 license be available to universities?**

We are working on a licensing for all of the RISM toolkits. So right now it is basically licensing for specific universities for specific collaborations so we would do the same for the NEUP call.

**Is there an interest in developing new statistical validation tools?**

If it is a novel approach it is more suited for the IRP, but if it is applicable to RELAP-7 it could be applicable here.

**Is there interest in RELAP-7 validation for non-LWR reactors?**

I haven't thought about that. I think that it is part of the LWRS program the emphasis will be for the current fleet of reactors. This topic is under the purview of light water reactor technologies. I know that RELAP-7 is also being developed for non-light water reactor technologies but I think that would be part of a different call to validate RELAP-7 for those applications. This is for light water reactor uses for RELAP-7.

**MS-RC-1 Overview**

**On slide 7, can we know what the 2 alloys in progress are for immediate term testing?**

The two alloys are Grade 92 steel and Alloy 709 for fast reactor qualification.

**Does high temperature reactor mean pebble bed or prismatic reactors?**

Yes, this refers to both types of reactors for this call. So yes, it refers to prismatic block high temperature reactors or pebble bed reactors.

**Is there interest in systems and economic analyses on small modular reactors for cost reduction?**

This particular call is for advanced systems or advanced reactor technologies not necessarily for their economic feasibility.

**Does ART also include integrated systems that you mentioned for HTRs?**

Integrated systems are of high focus in fast reactors and it can be explored in the high temperature reactor realm as well. Systems integration will be an important part for all advanced reactor concepts.

**Are new materials systems appropriate to propose to this area?**

If you are talking about enhancements upon current systems or components in materials then that could possibly fall under this area but we are more looking for systems and components not materials. There are other scopes focused on materials.

**What are the research issues for graphite?**

That is not my area of expertise so I would have to follow up with our technical lead on that.

**Are new fuels being considered for the MS-RC-1 area?**

Innovative fuel cycles have been explored in the past and are still underneath this scope for advanced reactors.

**Would any concept for LWRs be considered or just HTRs?**

We are primarily focused on Gen-IV reactors, HTRs are a subset of those. We are not looking at LWRs at this time.

**How do the Advanced Reactor Concepts scopes in NEUP relate to the recently announced DOE 's reactor's industry lead R&D?**

These scopes are looking for enhancements upon the R&D related research or we are looking for further systems that are more advanced and further in the future than in the near-term scopes that have been developed for this funding opportunity. It is a more outside the box type call.

**Are pebble-bed reactors still considered even though the U.S. isn't necessarily pursuing them?**

Yes, pebble-bed reactors are considered in this scope.

**What amount of RDD&D are you interested in for this new system? Are industrial collaborators encouraged?**

Industrial collaborations could be utilized in this call. Some people have used these collaborations in the past.

**Are new graphite concepts considered?**

If it is within the Gen-IV scope then yes it would be considered in this scope.

**Is there interest in analysis of breed-burn systems or approaches of lower dpa and high burn-up SFRs?**

Looking at high burn-up SFRs yes, we are looking for more burner type design for out scope and generally try to avoid breeder types.

**How many awards are expected?**

I am not able to ascertain that at this time because I do not know what the future budget will be.

**Is there any particular reason why HT-9 is excluded from the alloys of interest?**

I think the main takeaway is that HT-9 is not approved for nuclear construction purposes by the ASME Code, more modern alloys with better technical features have been identified, and an extensive database already exists on its potential uses as cladding material for SFRs minimizing the need for current research.

**MS-RC-2 Overview**

**Is improving plutonium-238 production considered in this scope?**

I think we have a pretty good handle on Pu-238 production but I would be willing to look at any proposal on the subject.

**What structural materials might be of interest for these reactors?**

Stainless steel is something that we really like. It has good radiation resistance properties and we like UO<sub>2</sub> as a fuel form. It has been in fast reactors before and we think it is fairly well characterized. One of the designs we were working on in the mid-2000s was a NaC-cooled fast reactor that used reflector rungs so that seemed like it was a workable solution for a small reactor as well.

**Is radiation damage an issue to be considered?**

We find that if we stick with some of the existing fuel forms the total displacements per atom are not that high. So I guess from a standpoint of electronics, yes, radiation damage would be important but from a fuel form I don't think that will be an issue.

**Is there any specific power density level you were expecting?**



I don't have a number in mind. Contact Scott Harlow for more specifics on this question.

**Is developing advanced thermoelectric generators within the scope?**

We are always looking for new technologies in thermoelectric generators so yes.

**Is proliferation resistance an issue to be considered?**

Proliferation resistance is always an issue especially when talking about HEU. Most new systems are going to be on a government facility site and there will be plenty of guards there to keep it safe from external threat.

**Can the emphasis be on thermoelectric material itself or does it require a reactor design?**

The reactor doesn't necessarily have to be coupled to a thermoelectric system, it could be coupled to a Brayton or a Sterling so I don't know how to answer that. We feel like we could get high efficiencies but here are downsides as well because you have more moving parts and you have to balance all of those things.

**Is the scope mainly focused on conceptual design or do you also support experiments and prototype building?**

Primarily paper studies at this time covering conceptual design.

**MS-EM-1 Overview**

**Is the budget of \$400,000-\$525,000 for one proposal or for two?**

We would expect proposals to come in at that range for the U.S. portion of that proposal. There would be similar funds from the Japanese collaboration to support the Japanese collaborator meaning the combined budget will be larger. The U.S. portion would be \$400,000-\$525,000 with the Japanese looking to match that for \$800,000-\$1,000,000 total U.S. and Japanese money. It is expected that there will be one project funded.

**Is a Letter of Intent required for this area?**

No, a Letter of Intent and a pre-application are not required for MS-EM-1. The full proposal is the only one that needs to be submitted for this area on February 18, 2016.

**The call for proposals specifies a maximum of \$400,000. Can we propose up to \$525,000?**

Yes, that is correct. The plan is to have a maximum of \$525,000 over three years.

### **NEET-1 Overview**

#### **Does additive manufacturing or 3D manufacturing under this workscope?**

Yes, additive manufacturing is in the scope. You can refer to other funded projects in this scope that use additive manufacturing.

#### **Are there any specific materials (i.e. alloys) that DOE might be interested in for this program?**

We are talking about the applied manufacturing side rather than the materials development side.

### **NEET-2 Overview**

#### **Is it required to have an industry partner as a Co-PI for NEET projects?**

It is not required but it is highly encouraged so you can find out what the final use of the technology will be.

#### **Does fault tolerant resilience controls fall under this scope?**

You have to make the case of how is it translating data or using data. The emphasis here is on communications technologies. If you are proposing new types of communication technologies that incorporate fault tolerant resilient control then perhaps, but if you are just proposing fault tolerance resilient controls as part of control technologies that would be less relevant.

#### **Are we looking for ways to improve the licensing process for I&C upgrades?**

That would definitely be a plus but not mandatory at this time. Proposers should consider that anything the entertain is going to be applied to a nuclear environment so it has to comply with existing requirements for nuclear applications eventually. How you get there is something you have to think about especially when you think about the demonstration environment. The path to qualification is beyond the scope of this project.

#### **Are you looking for a systems approach or novel device technologies?**

We are putting out emphasis on novel approaches but we will consider systems approaches.

## **NEET-3 Overview**

**Is characterization of HT-9 steels at dpa values much larger than 200 an area of interest?**

This topic is to develop advanced techniques rather as opposed to doing specific research on specific materials. If the proposer is looking to develop a new technique for this metal or any other alloys that would be in the scope.

**Can new materials be used as long as advanced characterization tools are used to characterize?**

No, the focus of this scope is the development of advanced, new tools as opposed to doing research on the materials.

**To what extent are high throughput experimental techniques for rapid new materials characterization encouraged?**

That would certainly fit well into the solicitation and would be of high interest to NE and actually across the department there is a push on high throughput techniques so that would certainly be within the scope.

**Would infrastructure resources be provided for universities to install or upgrade computer clusters?**

This was asked yesterday in infrastructure.

**This year will you only accept applications for characterization techniques and tools and not consider proposals on the development of new materials?**

That is correct. Our focus is only on materials characterization and sample prep techniques.

**Can ideas on advanced fabrication or joining be acceptable?**

No, the focus is on advanced characterization tools and sample prep.

**Is characterizing concrete materials under irradiation considered?**

Yes.

**Can the innovative MFG techniques (innovative processing) in 1.3c be used on existing materials or can they be on new materials?**

It could be older materials as long as they had been fabricated using the advanced manufacturing techniques. The focus here is the materials fabricated by advanced techniques.

**On the NEET-NSUF, IASCC what is the focus: materials development or new techniques?**

It would be materials development. It is understanding the phenomena of stress corrosion cracking in materials. So it could be advanced materials or materials that are currently being used in the nuclear industry.

**Are new reflector materials considered in any of these scopes?**

No, I don't see how that would fit, well perhaps in 1.3d the experiments with the synchrotron. That is a very wide topic on what type of materials could be researched so perhaps it would fit under that scope.

**MS-NE-1 Overview**

**Will analytical benchmarks also be considered in this program?**

I need more understanding of what is meant by analytical benchmarks. The key point of the benchmark projects is based on experimental data. Proposed benchmarks should include existing data, not just code to code comparisons.

**How important is it to perform uncertainty quantification, for example access cross section uncertainty?**

Cross section uncertainty is important but it not part of the actual benchmark analysis. You are looking at it as a chicken and the egg sort of thing. You need existing nuclear data and code to perform a benchmark evaluation and yet you turn around and use the benchmark evaluation as an integral test of nuclear data and codes to try to improve them. So typically the cross section uncertainty analysis is not part of the benchmark evaluation itself, it is something often performed afterward to show the uncertainty from the cross section component and compare that with the uncertainty, which are due to the experimental measurement geometries and material properties of the experiment itself. The are often tossed into an appendix, it is actually a growing area of interest because we could perform these really good experiment, even modern experiments, and yet are limitations are the nuclear data that define the models that we construct to evaluate them.

**Is the review and analysis of an old experiment in shielding considered?**

Yes. It would depend on the shielding experiments and how they fit into the smaller list. If it is shielding in small modular of boiling water reactor that kind of instance. If it is just a shielding experiment, like a rate maze or something, and just testing

particle transport, that is something that is of interest for the handbooks but not a DOE interest.

**Are previous TREAT experiment benchmarks still supported by this call?**

In the current call we are not asking for TREAT benchmarks. We would continue to receive TREAT benchmarks for the handbook but we would also like to fund some additional projects because the funding for the last NEUP went to TREAT benchmarks.

There were some dynamic TREAT benchmarks that are being selected and undertaken, though we don't know what they are, but there is a possibility of duplication. If you are proposing a TREAT experiment, which we are not asking for, know what is going on out there in the community so you do not duplicate current effort.

**In the second to last slide, is there a prioritized list?**

There was a much longer list and I asked John to reduce and trim it because we are going to award one or two projects. We would like to get a higher priority proposals and this is the list, if you do something else you are taking your chances. So to clarify, anything on the list is of equal priority? Well, no, myself I think a priority is molten salt reactors would be important because we don't have any benchmarks on them yet and there is a going interest in the FHL and fluid fuel. The LWR-PROTEUS experiments are very well characterized so that would be good to.

We tried to create a short list to indicate where there interests are where we are really lacking in the handbook. There is obviously a lot of experimental data out there that we would like to have in the handbook but we needed to have a shorter list. These are examples of some experiments that are the kind of quality experiments that could fill those gaps and we recognize that there are other experiments that could equally fill those gaps. There is a lot of need for nuclear data testing and reactor validation. So we needed a shorter list to help the reviewers. In previous years we would have a couple of slides and we would end up with responses of all different reactor types and we ended up having reviewer picking one reactor benchmark concept above another.

**Are you interested in benchmarks that could support the validation of high fidelity NEAMs and CASL neutronics codes?**

Absolutely.

**Are benchmarks of gas-cooled reactors of interest?**

The same answer I gave before, it is not on the list, but that doesn't mean it is automatically disqualified. It is not on the list of chosen highest priority

benchmarks. Part of the reason for this list is the number of benchmarks of a certain reactor that we already have. We have a lot of PWR benchmarks and a number of gas-cooled reactors, not so much fast gas but there is a lot of fast reactor benchmarks.

We do have a selection of different types of reactors in the handbook. You can never have too many, I've decided, each experiment was performed for a reason. Even if you have duplicate experiments in two different countries you don't always have the same results. With that being said, there are existing gas-cooled reactor benchmarks mostly graphite if you are in the thermal it's like HTTR or VHTRC out of Japan or HTR-10 out of China or ASTRA out of Russia so there is a small selection. There is a prior NEUP that went to University of Florida to work on the gas-cooled fast reactor PROTEUS experiment, so the shorter list here is to guide things towards where there is data missing in the handbook where we do not have molten salt reactor benchmarks or boiling water reactor benchmarks places where there are no existing benchmark data. So that is the priority to start filling in the obvious voids in the handbook even though there is a plethora of experimental data out there that should and ought to be evaluated for inclusion in the handbook.

So that is part of the priority selection but also we are interested in small modular reactors and molten salt reactors and nuclear data testing and so that is another reason they are on the list. They are important to the program and to industry.

**What kind of computational tools are required for the benchmark evaluation process, are there any specific requirements?**

You want to use tools that will work for what you are evaluating. For example, if you are doing a simple experiment if you look at some of the older benchmarks they were able to use 1D and 2D codes but early benchmarks you are dealing with simple cylinders and spheres. When you start working on reactor systems you are looking at codes with more capability: RZ-codes, 3D Monte-Carlo codes, etc. Essentially, you want tools you can use to actually mock up the model of the experiment and assess the uncertainties. I wouldn't be using a standard grade school ruler if I was measuring something on the order of micrometers. So it's the same thing here. Traditionally in the U.S. there is a lot of NTNP or KENO in the scale software suite, so different countries have their different codes. So it is up to the evaluator which tools they want to use, but if you are looking at using some of the newer tools that DOE is working on, like PROTEUS, you want to show it applies to what you are looking at. That is part of the benchmarking process when you mock it up in whatever code you are using to simulate that you show your computation results.

**NEAMS-1**

**There are five workscopes in the draft, 1.4 and 1.5 are separated out. Are they going to be one workscope or two?**

NEAMS 1.4 is going to be Thermal Hydraulics and NEAMS 1.5 is going to be Structural Materials. That will be easier to review.

**Are proposals focus on developing new nuclear fuels and materials using the NEAMS toolkit codes of interest?**

Yes, if there were a proposal that was exploring and expanding the application of a NEAMS tool form that we are not currently focusing on that would be welcome. In particular, we are always looking for ways to expand the utilization of these tools. So if there is a nuclear fuel that is not receiving high priority funding we would welcome a proposal in that area.

There would be an expectation that the proposal would include either use of, or generation of, appropriate validation data for that application.

**Are the NEAMS Toolkits the only appropriate computational platforms for proposed new model or algorithm development?**

In the past we have accepted proposals for work that have done development in other platforms as long as the proposal also includes effort to demonstrate the translation of that new capability into the NEAMS toolkit. I think that is a reasonable approach for us in general in development of NEAMS tool that is not restricted to NEUP. We occasionally develop models and methods in other platforms where there is ease of use issues that allow us to do that more quickly or more cost effectively but there is always the expectation and requirement that the capability can be moved back into the NEAMS toolkit.

**For NEAMS 1.1, is it necessary to use MARMOT?**

I don't want to close the door to innovative approaches that may be ultimately implemented to MARMOT. I can certainly envision atomistic work that might not initially include MARMOT but then ultimately would be of use. MARMOT is our primary tool for ultimately implementing more advanced mechanistic models into BISON so we are pretty much committed to that.

There are a lot of opportunities for work at scales that fall below MARMOT itself, as in the previous question the models that would be developed would be coordinated with the MARMOT team to be implemented within the framework of MARMOT at the close of this project.

**For neutronics coupling with fuel performance, do you require PIs to consider PROTEUS only or would using RATTLESNAKE be acceptable?**

We would welcome either. We're developing primarily PROTEUS but I think RATTLESNAKE is a tool that is starting to have some use in NEAMS, but the primary

tool in our toolkit is PROTEUS so we would look at it from that perspective. But we would be open minded to seeing what people could do with RATTLESNAKE. But the point is would the proposal result in a capability that would then contribute to broader use of the NEAMS toolkit, enhancement of the NEAMS toolkit, better validation of the NEAMS toolkit or at least provide data that would support future advancement of the NEAMS toolkit. That laundry list there is really the answer to the question.

There are two major NEAMS deliverables for FY 2015 that are coming due in September that are focused on providing a couple of MOOSE apps which simplify the integration of PROTEUS with MOOSE based components. That is a major effort that has been underway in NEAMS and would be our focus.

**In NEAMS 1.1 is modeling of irradiation effects on long-term behavior of concrete elements being considered?**

This is part of the long-term plan, but something that is not being considered in the current NEAMS program, and likely will not be in the term of this NEUP. The initial focus of NEAMS has been in-core with some slight extensions beyond the core for thermal hydraulic effects but we have not started looking at effects beyond the core barrel in any reactor concept at this point.

**Is there interest in adjoint methods for uncertainty quantification and coupled criticality and burn-up codes in NEAMS 1.3?**

The short answer is yes, there is always interest in uncertainty. I would advise anyone who is developing a proposal in this area to try to get in contact with folks already working in the area to make sure that their efforts are complimentary to the efforts already in progress.

**What is the difference between NEAMS 1.1 and NEAMS 1.5 for structural materials?**

The focus for NEAMS 1.1 is atomistic and mesoscale modeling and simulation and in that case primarily our efforts have been in fuels and cladding. We are trying to open that up to lower leg-scale work in reactor structural materials. In NEAMS 1.5, it is going to be focused on the core analysis. In 1.1 the connectivity is really to the macroscale fuel performance modeling described in 1.2. In 1.4 the focus is much more heavily placed on large structural components such as core support plates, core barrels, and those types of features in the various reactor designs that are not directly associated with the fuel but have an impact on core performance.

**Would detailed measurements within facilities that do not necessarily use water be acceptable for the thermal hydraulics area?**



Yes, depending on where the proposal was going to take us. We want to explore a broader range of reactor types which would include more than what we have currently underway. The focus for NEAMS has always been to develop a set of tools that are not necessarily tied to a specific reactor type. One of the challenges for the development of these components has been to provide tools that are flexible enough in their implementation to adapt to a wide variety of materials and design concepts. So I think that universally applies throughout the entire NEAMS call. The only reason I had a caution in my reply is that it is linked with advanced concepts that are explored by our major programs unless there was a compelling reason to consider something completely different. If the tools are to be more broadly applied, different materials, different coolants would be in play.

**For 1.1 is the envisioned balance in favor of coding and developing models rather than fundamental science such as microstructure evolution?**

To me, understanding the microstructure is definitely in play. I'm not sure we had some kind of balance in mind. How we would view a proposal would depend on the impact that work would have on NEAMS, whether it is in the understanding of the physics or microstructural changes that would lead to better models. The question is can the work that is being done be connectable to our program and meet our program needs.

**Are improved SN methods considered?**

The work in method development for any method is reasonable as long as it meets the expectation that the work has some assurance that this is representing the reality of the phenomena they modeled and also as long as the criterion that the proposal clearly defines the metric of success that illustrates a return on investment for that development effort. Yes, SN methods are certainly acceptable but we want to see a very clear anticipated metric of success that would justify the investment.

**Is modeling the effect of irradiation on stress corrosion cracking of core steels considered?**

Again, if you propose work in that area and demonstrate how it will help in the fuel performance modeling and failure prediction then it would be worth seeing. The key for us is to see a clear metric of success that illustrates a return on investment for expanding the NEAMS tools and our ability to address problems of importance to DOE-NE.

**Under NEAMS in general are experimental collaborations coupled with simulations fundable?**

The short answer is yes but it depends on the scope. We are not talking about codes or simulation tools here, I think the coupling is essential. I don't think R&D can be fruitful without it. If it is something that exceeds the budget that would have to be

broken down and taken one chunk at a time. If it were very compelling we could even consider alternate ways to approach it in future years.

**Is it expected that there will be several awards in the area as a whole, potentially one per workscope area?**

We believe that we will be in a position to fund one in each workscope area although we are not committing to that. We can't promise that, it would not be prudent or wise since we haven't seen what we get and what funding is available.

### **IRP-FC-1 Overview**

**I am new to this program. Is there a mechanism by which I can find a team to join? Can DOE serve as a 'go-between' between researchers?**

No, we are not matchmakers. We do have a sourcebook on neup.gov on all of the major players in the university field. Use the Neup.gov search function and use the title 'Nuclear Science and Engineering Sourcebook', that is how you access that document.

**Is there interest in development of adjoint methods for uncertainty quantification and coupled criticality and burn-up calculations for high fidelity codes?**

Within the NEAMS program there is an interest in development of uncertainty quantification methods for any aspect of reactors or fuel performance simulation. There is some room for that type of activity in the NEAMS call that will be discussed tomorrow, the NEAMS-1 call tomorrow. But for this IRP I don't not see how that would fit.

**Must the code of multiphysic code system employed be one of those you listed in an earlier slide or can one develop their own component codes as they wish?**

We gave it a lot of thought when we put this information in. We have been spending a lot of funds on those specific codes our first priority in this IRP scope is validating those codes in the suite.

**Can the V&V be focused on radiation damage?**

If there is a model that predicts that and a validation experiment that would serve as a benchmark for the code that might be appropriate. I think that in a lot of cases it may be acceptable and in others it may not. I think the primary criteria would be that we would like to see a benchmark that exercises some of the multiphysics connectivity within the suite of codes that have been developed. I think it is key to

recognized that while some other parts of the call are focused on separate effects experiment development, the key component of this IRP activity, which elevates it to a higher budget and possibly longer time scale, is the focus on strongly coupled phenomena that occur in fuel/reactor applications that requires some multiphysics treatment in the simulation of those phenomena.

**Is benchmarking only for the reactor parts or also for containment vessels?**

I believe that there is a separate call for tools developed by the Light Water Reactor Sustainability Program in validation of those components, which would be a more appropriate home for ex-core benchmark problem development. The next presentation IRP-RC-1 will cover that topic.

**Where can we find more information on the Methods & Guidelines Committee mentioned in the FOA?**

That committee is just being formed; there is nothing publicly available yet. This is something we are trying to establish as we move forward. But as you prepare for the project I can put you in touch with the right person during the project. If you have interest in working with them you can contact me before submission of the application.

**Is it a possibility that we could include these members in the proposal?**

It depends on whether or not there would be a conflict of interest. It will be evaluated on a case-by-case basis.

**Is adding advanced materials modeling components to the available codes and proposing V&V being considered?**

We have a suite of codes that we are trying to expand the regime for which they are validated. So creating your own code and trying to validate it is not part of this IRP. There are other calls for NEUP that would be interested in this activity. Within some constraints there interest in the addition of material modeling capability that is called out in the NEAMS-1 component of the NEUP call.

**Are you expected one experiment or a series of simplified experiments? (i.e. each experiment treats only one specific coupling.)**

We will have to wait and see what is proposed and how it advances the goals and objectives stated in this IRP. If you can do more than one multiphysics simulation then I don't see why not. In both NEAMS and CASL, we tend to think of validation as a progression of problems and tests that are used to provide some confidence that the appropriate phenomena are captured by the codes. So I would hope that even in the case where there is one large experiment that there is some progression that provides increasing difficulty. ON the slide that outlines the characterization of a

good validation experiment, the need to provide the progression of problems is called out as one of the six key characteristics. I think we would consistently be looking for the ways that the proposal align with this description of a good quality validation experiment in the review.

**Can the experiment take place in a different country if that country is willing to pay for the cost of the experiment?**

From a procedural standpoint, no federal funding can go to a foreign entity but you can collaborate with an international partner if they are willing to pay for the cost of their collaboration provided they are not a denied party and observe export control regulations.

**Can the analytical benchmarks be part of the V&V?**

We are looking for a new benchmark experiment.

**IRP-RC-1 Overview**

**Is adding GRIZZLY advanced concrete modeling capabilities considered if it is included with complete V&V?**

You would want to include GRIZZLY code as part of that. The focus on the IRP is on advanced V&V methods so GRIZZLY would be one of those codes but we would want a method that would apply to more than that.

**Is there interest in development of adjoint methods for uncertainty quantification and coupled criticality and burn-up calculations with high fidelity codes?**

Yes, core physics is more aimed at the previous presentation (RC-4-7). We are not doing so much with the core physics calculations within the RISMC toolkit. If there were methods that were being developed as part of that that would be applicable to these other codes I think the methods themselves may be of interest.

**What is the difference between this IRP and the RC 4-7 scopes?**

One of the worksopes, RC-7, is focused on validation of RELAP-7 specifically. In RC-7 we are looking at more traditional methods of code validation. When I talk about traditional methods, taking experimental data and running a code using the same input, as the experiment would have used and then validating the code that you get reasonable results that match the experimental data. It will be collecting that data, validating the code for certain scenarios as most code validation is done today.

The IRP is looking at different methodologies for code validation instead of the traditional method. The IRP is intended to be broader because it encompasses more tools and more scenarios and this idea of scale becomes more of an issue. And I would reemphasize it is intended to be more novel non-traditional methods of validation and to encourage thinking along that line.

**What empirical data sets will be used for validation?**

That depends on which tools are being proposed. For example, GRIZZLY is looking at aging mechanisms so then you would need aging related types of information. It really depends on the specifics of the proposal and the tools that are encompassed in that proposal.

**Are new test facilities required to validate these codes?**

I think we are encouraging use of existing data whenever possible. We do mention that if new experiments are need and can be funded within the time and scope then that could be part of the proposal. I wouldn't rule out some small-scale facilities built and used as part of the proposal. But the scope is not envisioning some type of large-scale experimental program.

**Are advanced sensors going to be employed for validation?**

If you have data from sensors that could be used for validation, Again, if you have some test facility that could add some better sensor that would give you data that would be more applicable to validation that would make sense. The emphasis is not on the test facility, or the sensor development or using advanced sensors or test data. I would put the emphasis on, you are not going to do enough tests to validate these codes, they are very complex codes that span a very large, broad field of phenomena that can be modeled so you can't validate your way through this code by building test facilities and running huge numbers of tests. That is exactly the problem that we are trying to overcome is the recognition that we can't run enough tests to get enough validation to really validate the full spectrum of the code. So what is a good methodology for validating codes when it's not practical to build these multi-million dollar test facilities to validate these codes? That is really the question, it is not about building test facilities or running tests to get validation data but on novel methods on validating the code recognizing that you can't spend all this money on a test facility.

**To be clear, not all tools have to be in the proposal?**

That is correct.

**Can you clarify again what traditional validations means? Is the program interested in calibration of RELAP-7 code?**

If was just a comparison of RELPA-7 to experimental data like was done with other codes like RELAP-5 and TRACE and others, that would fit into the other call, RC-7. The IRP call is intended to think-outside-the-box and leverage different types of data not focusing on one tool but perhaps a spectrum of tools from a safety margin perspective.