PRIVATE FACILITY RESEARCH (PFR)
PROGRAM WORKSHOP

Sponsored by the

U.S. Department of Energy Office of Science, Fusion Energy Sciences Program

at

Princeton Plasma Physics Laboratory

MEETING MINUTES
FEBRUARY 29, 2024

Private Facility Research (PFR)
Program Workshop
February 29, 2024
SUMMARY OF MEETING

The U.S. Department of Energy (DOE) Office of Science (SC), Fusion Energy Sciences (FES) program sponsored a hybrid in-person/virtual workshop on February 29, 2024, at the Princeton Plasma Physics Laboratory (PPPL). The goal of the new PFR program is to offer the opportunity for publicly funded researchers to conduct open scientific studies on privately constructed facilities (including non-fusion facilities) for the mutual benefit of all parties. The purpose of the workshop was to convene the U.S. fusion and non-fusion plasma community, from both public and private sectors, and shape this new PFR program. Attendees were subsequently divided into breakout sessions to consider three program elements: (1) the establishment of public data repositories for preserving data generated by private facilities, (2) an annual solicitation open to public sector researchers to propose scientific collaborations involving private experimental facilities, (3) the exploration of modalities to access private facility run-time in support of public researcher experimentation under FES.

Organizers
Josh King, Program Manager, FES, DOE SC
Colleen Nehl, Program Manager, FES, DOE SC

Speakers
JP Allain, Associate Director, FES, DOE SC
Stan Kaye, Director for the National Spherical Torus Experiment-Upgrade (NTSX-U) Research Program, PPPL
Ahmed Diallo, Principal Research Physicist, PPPL / Program Director, Advanced Research Projects Agency-Energy (ARPA-E)
Chris Barr, Program Manager, Office of Nuclear Energy (NE), DOE
Mary Yamada, Associate Director of Innovative Partnerships, Office of Technology Transitions (OTT), DOE

Subcommittee Breakout Moderators
Josh King
Colleen Nehl
Carlos Paz-Soldan, Associate Professor, Columbia University
Rich Hawrulyk, Senior Technical Advisor, Office of the Deputy Director for Science Programs, DOE SC

Notetakers
Sonia Isotov, Oak Ridge Institute for Science and Education (ORISE)
Aiden Layer, ORISE
Marci Savoy, ORISE
Natalia Travis, ORISE

Thursday, February 29, 2024

Welcome and FES Introduction, JP Allain

[Presentation posted]

Discussion

Question: This is very visionary for what we need. The translational gap is the challenge, and one of the things thought of when mentioning "technology" is the assumption that we are further down the technology readiness level (TRL) line. We need to understand that the technology comes from the science. Creating the technologies of the future requires a deep understanding of the science across fields beyond just plasma. Does that resonate with you?

JP Allain: To me, the question is: where do we think we are with that technology? Some may define a particular technology as mature, while others may consider the same technology to be immature. We need to find a common language. The question is finding out where the private sector roadblocks are and meeting them with expertise. The challenge is ensuring that there is a bridge back to the expertise. There are a number of technologies around fusion that require a push from the public sector.

Comment: If you look at where the industry is today, there is a lot of focus on the demonstration aspects of the technology, but there are a lot of known unknowns that will have to be developed in parallel. Setting up this infrastructure now allow for us to deliver on that. If the private sector's aspirations are going to be met, there is a finite timeline to integrate and deliver into the system. Getting the foundation set up today is strategic for the United States.

JP Allain: We have to do things fast and in parallel, and there may be some challenges around the regulatory aspects of that. We have to make sure that with fusion there are parallel efforts there to make sure that the public sector is there and is not reactive.

Comment: On the university side, there are some universities that do the bridge better than others. It is a matter of evolution; they are following some rules that make it more difficult to make that kind of partnership. If DOE provides that leadership in the form of language and Funding Opportunity Announcements (FOAs), it can assist and guide the universities.

JP Allain: That is a very important point, and even non-Very High Research Activity (R1) universities are looking to be involved. Assisting them with the technology transfer aspect is important.

PFR Agenda, Program Elements, and Charge Discussion, Josh King

[Presentation posted]

Discussion

Question: [Question off-microphone]

Josh King: Since we are discussing modalities for labs and universities, all of those mechanisms are open.

Question: Often a DOE award will put pressures on the host to make the award happen, so will resources be given to help alleviate those pressures?

Josh King: That will be captured and is a good note from the workshop.

Question: [Question off-microphone]

JP Allain: The point of the restructure of the FES budget is to reflect what our priorities are. The example was a plasma science example, but we see across technology development. The point is for us to be inclusive around technology development that needs that kind of push. This is the first of many elements around our public-private partnership engagement that we would like to develop around FES.

Program Element 2 – ARPA-E Diagnostic Capability Team Example, Ahmed Diallo

[Presentation posted]

Discussion

No discussion.

Program Element 1 and 2 – Spherical Tokamak 40 (ST40) Example Project, Stan Kaye

[Presentation posted]

Discussion

No discussion.

Program Element 3 – Nuclear Science User Facility (NSUF) Program as an Example Modality to Access Private Facility Run-Time in Support of Public Researcher Experimentation, Chris Barr

[Presentation posted]

Discussion

Question: If you have private sector and public sector users, how do you get alignment? Does everyone have the same degree of say?

Christopher Barr: We have open and competitive projects, and the projects are evaluated using the same technical merit criteria. We have a good distribution of industry projects (on the applied side) and university projects (on the fundamental side). We have a Consolidated Innovative Nuclear Research (CINR) FOA process, and the lab call for more focused shorter projects.

Break

Subcommittee Breakout #1

Group A, Element 1 (Data Repositories)

Comment: Any public entity or any public university or lab which shares data has responsibility to have an agreement from the partner before they publish it.

Comment: It has been clear that lots of data from even the public laboratories has not been easily accessed.

Question: What happens when industries or companies cannot survive and take their data?

Comment: I think there are two elements here. There is the protection element of the repositories and there is the preservation element. For example, Tokamak Fusion Test Reactor (TFTR) data preservation effort where we have been funding PPPL at a small level to try to

transfer from old tapes that are decaying data tapes onto modern servers. We are hoping to have a website up with that data available to people. Even within our system, this is an example where we have essentially started to lose this amazing data set.

Comment: Likewise with private companies that may go through a bankruptcy or something like that.

Comment: We need to preserve this data beyond once, as those companies evolve and move into a fusion pilot plant (FPP) or something like that and have no interest in holding on to data from a facility that they had initially.

Comment: Tokamak Energy is a good example. There were no intellectual property (IP) issues involved. Technological capabilities of national laboratories are interesting. The behavior of materials and the neutron irradiation or how to manufacture a blanket, ceramic blank, those kinds of things are valuable. How can we set up a system enables private industry and national labs to work together and share that data and set up IP rights in an equitable way. That's the hard part.

Question: How much IP are you considering doing? Company by company or research facility by research facility? You can choose how much IP you want involved in a project.

Comment: Interesting point. At a proposal level, establish what data you think is necessary.

Comment: Choose a project with a specific scope. Some projects will not have an IP score, and other would enable different terms.

Comment: Dealing with IP protection for companies is going to be a bit of a nightmare.

Comment: The spirit of the program is really focused on the non-proprietary elements. If you are aimed at doing something non-proprietary, that is where we come in.

Comment: Very limited when it comes to funding. Structural components of plasma facing components (PFCs) are experimental matrices. Those are quite expensive and time consuming.

Comment: With data repositories, there is very big push to publish.

Comment: What is called a public repository should be called a collaborator repository.

Comment: Data management plans are not strongly enforced. There might be categories that require certain classes of data, maybe the way is to kind of upfront say this is going to be a project that solely involves IP-related data. The key point is preserving the data and ensure good scientific practice. Enforcing that the data actually gets us there and is important. Just having the data is nothing without the tools to process it.

Comment: In the commercial world, we have access to source code. We pay services to put it in escrow. A third party has a contract that says when you get access. Examples are out there. I understand you would want to protect and having a strongly aligned incentive, i.e. if a company pulls data out. That can sour the relationship. If it is really available, it can make a really valuable program. If you are in a multi-element game, you will not want to screw over your partner.

Comment: Respect and mutual trust are important.

Comment: Look for the wins and not the hurdles and barriers. Each party has incentives to make it work. For example, at the Massachusetts Institute of Technology (MIT), it is a requirement that we be allowed to publish our results. There cannot be an absolute veto from publishing our scientific results. That is a win for everyone. They should want to know if an approach will not work. Peer review and publishing is one way to do that. We all want a

successful fusion industry. Look at all examples of where these examples are working. Some is government enabled and we want to increase that.

Comment: There is no official veto and that is the protection.

Comment: I agree that we need to look for the wins. We might get caught up in the modalities. We are talking here about U.S. government sponsored programs. Providence of funding is important in how we handle this. Data needs to be available to the public. Company-sponsored should be individual conversations between those institution. Worried that we will get lost in the number of modalities. What we are talking about is how FES will handle this.

Comment: Telescopes is another example of government-funded facilities, i.e. James Webb Space Telescope (JWST). Whoever finds results first should be published first but that is not how it works and there would be no reason to build the telescope. How it works, if you work for the government, you get that data first and time to digest and publish, scope based. Later the data becomes available for everyone. If you know the scope and know the time period, you can meet the long-term goal while preserving short-term structure.

Comment: Exciting to hear private companies talking about their interest in competing in publishing this data.

Comment: Provenance matters where the money comes from. Sharing arrangement is first off who paid for it. National Aeronautics and Space Administration (NASA) CUDA is an example. A lot of people benefited and profited. Having a robust program leads to a solution.

Comment: Talking about having well-defined scope sounds positive, but be careful with not to have access to the data outside of the scope if we are not going to use because it is very different. Access to data and limited to what you will do with it.

Comment: If a company produces data on a diagnostic made by private researcher and a public researcher, they should both be wanting to co-author that.

Question: Data is not always experimental and can be abstract. What is the metadata and where should it be stored? Servers? Who does it belong to? Working examples of Trans simulations. Private companies are already using Trans. That could be a working example of this.

Comment: We have been discussing alternative options. In the event we implement these repositories, any comments about the level of effort we anticipate that would be required.

Comment: We do not want to lose our data and neither does the government.

Comment: Be mindful that we live in both the classified and unclassified state. We need separate computing systems and processes. If they are going to have a public side, they need a private side partitioned in some way. It is challenging to navigate in terms of getting full range of information to analyze the data, which may not be readily available because of the proprietary on the company side.

Question: Do we want to try to write something down? There have been comments about alternatives. Publication rights without veto offers an alternative.

Comment: They might not recognize which data is real or private.

Comment: Having provisions that account for timelines that consider protection of IP and also for publications.

Comment: This seems like something the private sector would be interested in. Provision for delay in publication to give time for IP protection where proprietary information is also involved.

Comment: There is the example of MIT publication of Commonwealth Fusion Systems (CFS) coils.

Question: Are there any contentious elements?

Comment: For alternatives, the escrow kind of thing. Put it somewhere but never access it unless something happens. No one has access to it. It is a backup option.

Comment: There should be upfront agreement and research scope on what people will do.

Question: How long data should be preserved in general? Some conditions for this would be good.

Question: Who covers the costs for the additional systems?

Question: Cost of repository?

Comment: Yes.

Comment: If it is outside of the scope from what the private company would be doing anyways, I would suggest it should be covered by the company.

Comment: Provenance and correlations between who pays for the work and who pays for the repository.

Comment: The public simulations involving private data must also be made available back to the private companies.

Question: What's missing in the framing is why should the company be happy? You are halfway around the flywheel. That data has to make the tools better. Make the simulation and design better. You are trying to build a flywheel, so how do we finish that resolution. If we contribute data to a database, then do not we get a stake in using it? We have to capture that. This is all in service of that. How does private company benefit from the results of the sciences and from the results., i.e. gyrokinetics?

Question: Who paid for the work – and does it matter? I believe it does. Worth noting, if work is on a private machine there is probably more money than went into the funding the person to do the science. We shouldn't conflate that with the government paying for that.

Comment: We are talking about leveraging billions of dollars in that kind of investment. A dominant factor.

Question: On the gyrokinetics point, building off of decades of work, now they are being applied. How does that flywheel loop back to where the cost benefit to all involved? The application is happening and is validating boundary areas and modifications to the physics. How does that both help that particular party and advanced things in general?

Comment: I have a statement in support for open source. The guidance is that open source is something the programs wants. That guidance helps when people are trying to decide what to do. That should be our default and then choose other licensing if that is not possible. Thinking of simulation codes in this case. The idea is to try to make open source the default solution where there is no reason to do so otherwise. The default at Max Planck Institute is to be closed source. When you need something, you have to get permission from everybody.

Question: There's the example of JWST data. Does FES have a policy on government-funded research? Does that publicly funded data become available to the whole community?

Comment: There is a generic policy that all FES data becomes available, not a specific policy. Each individual principal investigator (PI) puts through a data management plan; there is

a generic statement about that. Each program within FES would be willing to contribute to open sources and sites but there is no specific FES policy.

Question: You are supporting pre-competitive research at government institutions and labs and universities to directly enable the fusion industry effort. How do we get access to that?

Comment: We can scope out how different SC facilities do this. Everyone is different. Having a culture of collaboration is probably the most important determinant in how all this works. Everyone can look at it or no one can look at the data until I look at it. I think we want to be in the middle.

Comment: On code licensing, we have had varying experiences with access to these tools. In Europe there have been massive limitations in getting access. There's a much better experiences in the U.S.

Comment: Private data is used to improve codes; the private companies deserve access to them.

Comment: Trust building needs to come from both sides.

Comment: On ST40, there is a great deal of collaboration, mutual respect, and trust. Let's engage the companies and create a broad framework; we made a shift to say there is mutual trust.

Comment: We are looking for a win-win situation. If a company gives us non-proprietary data, then the collaboration will be better for everybody. We do need to build trust on both sides.

Comment: Atomic data is a win-win example of where data is available to private companies that subsequently improve tools, public databases and codes.

Comment: A lot of this public work is going to be done by graduate students; they come with their own timelines and that needs to be protected.

Comment: Timelines for these awards can be addressed in the solicitation section of this workshop.

Comment: On the sharing of public data, a lot of journal articles require mandated data availability statements. There may be a gray area of what is reasonable. Should it be free access to a journal article? This data is parenthetically open source but realistically it is not.

Comment: The process of public funded experiments versus potentially private, there is a difference – make sure the system works and validate it. Is it good data? Then give developers the opportunity to exploit that for some finite time period. These private facilities have particular mission goals. I'm putting a new system into a private facility now; this needs to be taken into account early.

Comment: Implementation of these types of diagnostics that go beyond magnetics. They need some degree of implementation at the specific facility and that period is a certain duration. Your point is basically whether and how that data gets made available broadly, back to the private company.

Comment: Something looks straightforward early on, but something comes up later on, maybe technical deficiency, so that we are not sure of the solution. We should make most scientifically justified access to the data as quickly as possible.

Comment: Aligning the goals of the organizations is super important. Most successful projects are the ones where the FES goals are aligned with that team. Figuring that out early is important. Differences in the organizations may cause tensions, but we will get through.

Comment: MIT collaboration has a really well-defined escalation path. You cannot rely on individual researchers and the CEO or the director of the lab solving all the problems all the time. How do you have the discussion? Even at the data management plan level, how is that going to be managed? We literally role play this and talk it out.

Comment: It is often said that the person who generated or built the diagnostic likes it the least. That process needs to be worked out so it's a win-win ultimately.

Virtual Attendees, Element 1 (Data Repositories)

Charge Question 1: Discuss the partitioning of proprietary and non-proprietary data and the sharing of non-proprietary data with publicly sponsored PFR program collaborators.

Comment: Most of the people on the line [in the group] are customers and would like to have access to as much data as possible, but unless there is industry representation there is not much we can do.

Comment: We do not need consensus in this process. There is going to be proprietary data that will never be open to the public. I do not want to talk about that part, I think this is about the part that would go public. There is a need for a phased approach. I am a proponent of open and Findable, Accessible, Interoperable, and Reusable (FAIR) data, and I think all public data should be open (similar to how NASA makes their data open). However, there is an embargo time which delays publication. Any data which is made to be public will be first used by people with direct access or agreements. I think the data should be open to only the people working on the project, and then after two or three years any data which is non-proprietary should be completely open to the public. It is a phased approach, and there is data which will never be touched and data that will be embargoed. It should be made public to at least the United States, but ideally the whole world.

Comment: The DOE agrees and is pushing for this as well. The United Kingdom Atomic Energy Authority (UKEA) has a 2- or 3-year embargo after which all the data becomes publicly available.

Comment: In establishing the public/private partnership, we should think about what we have to offer them. We have decades of experience in this field, and we can help them meet their milestones. The data is essential to helping them accomplish their goals, so this is sort of a trade.

Question: I agree, but is there a point about partitioning the data?

Question: I do not see why physics data should be kept secret. Some things could be negotiated. IP can really get in the way, and I do not know why there is a need for secret data unless it involves releasing things on a certain schedule.

Comment: Private companies will be very selective. Is there going to be a rule that they need to post everything, good and bad? I do not think they will agree to post negative results. I do not know how you will get private industry to post things other than purely neutral or positive scientific information, but they will not post things that negatively impact their bottom line or ability to get investment from investors.

Comment: This will vary depending on the company, and maybe this needs to be a prerequisite for companies getting public support. I have more of a concern for understanding the data. I think the good players will probably be welcome to have their results looked at.

Question: When we talk about data, are we talking about only the results of plasma data, or are we talking about operational data (which can move into the technology space)?

Question: One question is proprietary data—what is the definition? Would negative results be classified as proprietary? This is a question which several people alluded to. Then there is user access as part of the agreement needs to be shared and made available. Thirdly, all data that was publicly supported should be made available after an agreed upon duration.

Comment: I agree with the second and third points. My view is that negative results should not be proprietary, because it goes against scientific honesty.

Question: But how do you force companies to post that data?

Comment: They will have to make some compromises if they want public money.

Question: Will failures be part of the data everyone has, or will it be buried somewhere?

Comment: I was trying to imagine what a negative result might be, and I cannot think of a negative result. If a company makes a claim to their investors and the data shows that the claim was wrong, that would be a negative result.

Comment: I'm confused about people deciding after the fact which data is public: if the agreement is made before the fact, then the entire data should be made available. The agreement should be made in advance.

Comment: I think user access must be shared and made available to the publicly funded users. I do not think we have consensus on how publicly available data should be; we want to convey that there are pros and cons to full public availability.

Comment: The proprietary data definition should be taken care of through the licensing agreement. Also of note is that publication is different from data being publicly available. If a negative result is included, can you be stopped from publishing that result due to internal review of the papers? Even on the public funding side of things, there can be specific messaging which is why we have internal paper reviews. It is different depending on which facility you are collaborating with.

Comment: I think we can highlight that this needs to be clarified in the licensing agreement.

Comment (via chat): A more general comment about Element 1 – I think we may have a bias in thinking about mainly "science-supporting" data, but the charge also covers technology and technology-enabling data. The latter will likely be proprietary by default. On the other hand, often scientific data cannot be disconnected from technology to allow thorough validation.

Comment (via chat): The embargo time could address results considered "negative", but there would be a maximum embargo time. To me, Doublet-III-D (DIII-D) review is consistent with its public funding — it ensures correctness but does not seek to impart a political agenda or filter negative results.

Comment (via chat): A negative result, which might be a missed performance milestone, could be an existential risk to the company if the next round of funding depended on that result. Companies will want control to suppress negative data. If they do not get it, it will reduce participation in data-sharing.

Charge Question 2: The regular (e.g., daily) mirroring of non-proprietary private facility data to a centralized public repository both protects public collaborative research investments and preserves essential data for both public and private benefit, but it is not intended to be the primary data access point. What criteria could warrant public researcher use of data stored in a repository (e.g., in case of company bankruptcy)?

Comment: This connects with the point about restricted accessibility or an embargo to data. This is connected to the data licensing scheme, which should be negotiated ahead of time.

Comment: Non-proprietary data means there is no IP or licensing issues associated with it.

Comment: It is good to establish that definition in the cooperation agreements. Chris Barr mentioned the nuclear research data system, which is a centralized system shared between private and public partners. We would need to come up with a similar type of infrastructure which allows ups to separate out the authorization and accessibility aspects.

Comment: Your point is that establishing a clear definition of "non-proprietary" would be beneficial.

Question: Where is the repository, how is it maintained, what happens if the company goes bankrupt? These are important questions to ask. I would argue that any company that has their data mirrored or receives public funding, if they go bankrupt their data should become DOE data which the public can learn from. I would not want to see knowledge lost because a company goes bankrupt.

Question: I agree, but I want to note that if a company goes bankrupt, they have failed in their mission, so who would care to look at the data?

Comment: The internal review process is beneficial to both sides, and if they have not released their data into the public domain, they reserve the right to review the publications using that data. For the negotiation to get access to data, private companies do not necessarily have access to the ability to perform large simulations and supercomputers. This is something we can offer as negotiating power.

Comment: I ran a fusion company for five years, and our data was lost. However, this was not because the idea was bad; we just had competitors who were better funded for us. If our data became public, it might disincentivize us from trying again. How do you decide if a technical approach is worth pursuing, and how do you convince an investor? Unless you have significant flexibility financially, and if the data is shared it may no longer be of use to you.

Comment: To propose a simple criterion: the repository should be there to make sure that at minimum the researchers who have agreements with companies to work with the data should maintain access to be able to continue their research. A minimum criterion can be easily agreed on.

Comment: Some companies receive public support, and some do not. If CTFusion had a public place to put that data, it is an insurance policy against future loss. This can be a way for the investors to recoup some investment if they could sell that data or DOE would potentially pay for that data. The overall motivation here should be how are we going to help companies get fusion on the grid; it should address the needs of the private sector. The major motivation here is what does private science need, and how can we facilitate not losing data. If CTFusion were to recover, how could they obtain their data in the future.

Question: There is a tension where some companies may want to restart, and should the data not be publicly available for these cases?

Comment: I support that, and maybe there can be a time limit such as five years.

Comment: There is anxiety about open data, and there is still expertise needed to understand fusion energy data. Down the line everything should be public after an embargo.

Comment: At minimum, if a publicly funded researcher loses data access for any reason, they should have the data available to them. If their primary method of data access is not available, the repository would continue to provide access to the researcher. At a minimum, the repository would ensure that publicly funded researchers would maintain access to the data for their research in the even other data access is not available.

Charge Question 3: Are there alternatives to data repositories that achieve the same protections?

Question: To me this question refers to whether the repository is spread out, centralized, run by DOE, etc. And are their tiers of repository? I can see tiers where it is quasi-repository, and the data could be embargoed for different amounts of time.

Comment: On license agreements: it may not be held in a specific data repository, but there may be a specific license agreement which allows for users to access data. Other than that, I do not know of other alternatives to data repositories.

Comment: Cloud-based services can often have data stored at foreign locations, which should be recognized and considered.

Comment: There are some cloud-based services which deal with DOE data.

Comment: We discussed licensing agreements for Charge Question 3, but not much came up in discussion.

Comment: If a repository were not available, a licensing agreement would be necessary to ensure access.

Question: I collaborate closely with the University of Wisconsin, and I have access to data, facilities, and the entire institution through a visiting scholar appointment. There might be a way of establishing such positions within the companies that provides the research with access to resources. In doing that, they would have to sign some sort of non-compete and non-disclosure agreement. A "visiting appointment" agreement would be another mechanism. How can we, as an external collaborator benefit, and how can they benefit from our participation?

Charge Question 4: The establishment and maintenance of data repositories is non-trivial. Discuss anticipated public and private levels of effort. Should private company costs for establishing public data repositories be supported by FES?

Comment: Having the companies pay for the costs would raise the barrier to entry and create difficulties for them to share the data. We should lower the barriers to entry by having FES cover the costs. If companies go out of business, we want the data to be maintained, so federal funds here would assist.

Question: What are the benefits and the costs to the companies? There has to be a clear benefit for the private side to invest in this.

Comment: One benefit is validation from publicly funded and independent researchers of their achievements. This question is tied to the way that the data is being shared, and one request we can impose on private companies is to avoid data dumps and we can impose best practices to make sure the data is searchable and understandable. That can ensure usability of the data itself.

Comment: You need metadata for the data to be useful.

Comment: Yes, adhering to standards allows for better interpretation and reuse of the data.

Question: Should the costs of supporting the repositories be borne by FES, if using the repository is a condition of FES? If it is going to be a mandate, it should be paid for by the government.

Comment: If FES supports the repositories, it gives FES to enforce standards, data uniformity, and establish an agreement that is uniform and under FES control.

Comment: A guarantee that a public researcher can continue to use the data can only be done with the proper metadata and with validated metadata. There has to be consensus on standards, such as FAIR standards, that need to be applied to make sure the date is usable.

Comment: If FES supports the repository, they could perhaps establish a uniform IP agreement that is not onerous to the companies providing the data. Perhaps there is a way to write down a reasonable agreement.

Comment: We should reduce barriers to ensure that the data is available. In general, we still have not learned how to efficiently navigate public-private partnerships.

Comment: At Lawrence Livermore National Laboratory (LLNL), companies pay for analysis, and they maintain full control. Reducing the barriers is important; they have to see a clear benefit and it has to be easy.

Comment: If you are not a large company, every reporting requirement or license agreement takes bandwidth away from doing science.

Comment: Reducing barriers for the private side was the main point.

Charge Question 5: Is there private company interest in mirroring their data to a public repository even in the absence of an initial public collaborative research effort?

Comment: Yes. Something we are seeing is the broader fusion community is the rhetoric on who is where on this. Some companies are very open and share their data. I think there is an interest for private companies to have their milestones verified by experts, and for this there is some level of minimum data that must be shared. There should be an interest from the private sector for access to a limited amount of data from the public side to independently verify milestones. Having researchers provide credibility is incredibly important. Some companies communicate only through press releases, and some communicate through peer-reviewed journals. It would benefit the private industry if scientists can verify whether companies are meeting the milestones that they set out to meet.

Comment: There would be conditions under which private companies would share data, such as who would have access to the data. There are companies with widely different approaches to sharing data, and this could cause opposition in some areas. If they are not accustomed to sharing, then it may be harder. The real threshold is whether they can persuade their investors, and if investors control the IP, they believe that they may be able to make money in the short-term. Putting down a simple rule might be hard.

Comment: For this charge question, "We think there should be but recognize that the culture in different companies varies."

Comment: We do not have much private representation in this group and cannot fully comment on this.

Comment: It would really help if claims made in press releases would have some support/validation, and I think it would be to the benefit of companies and potentially attracting investors. Public vetting of the data builds trust.

Group B, Element 2 (Solicitation)

Charge Question 6: A fundamental tenet of the PFR program is the freedom of public sector researchers to publish experimental results from private facilities. Identify sensitivities and paths for resolving them (e.g., 1 mo. publication embargo for private company courtesy review).

Comment: Question 6 is important. Publications from the public sector are expected but from the private sector it is somewhat limited.

Comment: For example, the scope of the program sets it up for success.

Question: How could this go forward? Mutually agree on processes before beginning, set boundaries and have mutually agreed outcomes. Identify areas for symbiotic relationships.

Comment: Public taxpayer money should lead to publications. Private companies decide what should or should not be published. It's not that simple for public researchers doing research in private facilities.

Comment: There should be written statements from both public and private sides.

Comment: There are university rules for Innovation Network for Fusion Energy (INFUSE); public and private should remain separate due to conflicts of interest. DOE can be influential by making statements and rules for being less restraining, especially in universities.

Comment: Most in in the public sector want publishing. The impact can be measurable.

Comment: Framework for outcomes: the private sector delivers first of a kind a submission for design where public and private can come together to determine infrastructure-parallel development between public and private such as companies and labs. This advances the fusion sector for delivering fusion technology.

Comment: Participation on projects use a collaborative tool where everything is laid out and cleared before publication can occur (on a project management platform).

Comment: In a private sector framework, you might share data with participants only (private-private) or private-public before going public. The program determines the publications that could go forward, the prime calls the shot. Defer to this partner due to proprietary information and could be possible with the national labs. The prime's company is the one paying for time and leading the experiment.

Comment: DOE is paying for the time, but the company wants to determine what is published. It could be in DOE interest not to publish everything.

Comment: All this could be worked out, but the individuals need to be aware of new constraints. Education of private sector by public researchers should be established, trying to make this divide smaller. For example, in some public-private buy-ins, publishing could occur and then after several years. People on both sides should clearly communicate the details of the publication. This should occur throughout the process, like a road map with touch points throughout.

Charge Question 7: Public sector experimental collaborators are expected to have an appreciable on-site presence at the private facilities (e.g., those contributing diagnostics and other hardware). Discuss preferred paths for site access, safety, and data access?

Comment: Private facilities have pre-existing rules because they have many visitors.

Comment: DOE should indicate minimum standards for affiliates such as basic forms of training on site.

Comment: Include liability and additional confidentiality.

Comment: National labs are much less restrictive. I have full access to whatever I created. This is different from a business.

Comment: Even though national labs have visitors, areas are restricted and capped. But if you are an affiliate, that allows you to work with everything there with access to all the labs.

Comment: Labs have basic training such as radiation safety for example.

Comment: This is something that would be built into the agreement (with private facilities), including safety components.

Charge Question 8: How can public sector scientists most effectively deliver their proposed research objectives given the quickly evolving research plans of private facilities? What flexibility is necessary to ensure timely publication of research results?

Comment: The best practice is narrow scope. Is there a better metric? Solve the speed problem, then the flexibility problem is solved.

Comment: Should also consider any lag time. INFUSE, for example, has been offset by one year.

Comment: If a company plans an experimental campaign next month, they must have the capability to do a measurement in relation to an experiment. If they do not have the capability, then they cannot do the experiment.

Comment: Scattering may be used.

Comment: The public needs to have a faster mechanism to provide support. Time scale has been an issue. The umbrella creators set up the structure for collaboration with task lists in place then can improve the timeline. They can establish the money and time for the proposal. Task lists can also be modified in a flexible manner and approved at low levels once the umbrella created is already in place.

Comment: Like an indefinite delivery/indefinite quantity (IDIQ) contract with an indefinite quantity or scope.

Comment: Setting up a consortium is another mechanism. They set up the agreement and the clearinghouse to make this move more quickly.

Comment: A simple mechanism, such as an agreement with a consortium can be where the funds come from.

Comment: If we are looking to move the U.S. forward, look at what some German companies are doing at the collaborative level.

Comment: The standard contractual framework and scope German companies have signed include a memorandum of understanding (MOU) in order to operate together. They are doing a lot of things that we are talking about and engaging the public as well. Should look at some case studies on how this works.

Comment: Charge Question 8 also piggybacks on what was discussed earlier.

Charge Question 9: To ensure both depth and breadth of fusion research within the PFR program solicitation, a tiered system based on $nT\tau$ is being considered. Discuss options for such a tiered system. How should non-fusion efforts be weighted?

Comment: I do not think the tier system $nT\tau$ is necessarily the best. You could make some judgement of the technical readiness (like how much physics risk). We have proven physics on a dipole but there is a certain level we have not done. Those would become our company's milestones. The public or DOE can join us.

Comment: It's good for machines that have been working for 50 years, but for progress or something new, I think you would get disappointed.

Comment: I hope you also measure risk. That's the question. Should the public support risky options?

Question: Am I the only person who doesn't understand what a tiered system based on $nT\tau$ means?

Comment: You can do it in the same way as milestones. A comment made at registration is that you may be at a lower TRL and that is where the public sector can carry most of the load.

Comment: But you can reverse that to higher risk and a longer time scale.

Comment: If it is not plasma-related, what are we trying to advance? There should be a research capability involved and not a technology company. A research capability is a universal problem that needs to be solved. Say it's lithium or energy conversion. We should look at the topic and the outcome of the research and this should be a driver for relationships. Demonstrations are not enough. Partnerships can be a mix of private and public, grayer, and more mixed, and can result in more solutions. It all comes down to who is issuing the solicitation. The public side wanting to do private work or the private side wanting public involvement?

Question: What if a facility is not producing plasma? If you need to build a new machine, your $nT\tau$ tier level is zero. Will it get funded? If the machine does exist, the tier level is nonzero. $NT\tau$ risks pushing people to the top or to the bottom by grading them.

Comment: One might argue with that. It is more like a Spotify playlist. Everything goes to the top as most listened to track so if everybody is at the top tier, this will attract more attention. Really risky things may also need public funding. If you have one company that is unique from the others but still part of the program, then $nT\tau$ may not be the right metric, because this part is not just plasma or fusion. There are breaches between public and private and bridges are not completely built. You have one group that says $nT\tau$ and another that says risk. Which one is public, and which one is private? It's pretty obvious.

Charge Question 10: How can public sector researchers expedite the achievement of research-grade plasmas on private facilities?

Comments: It must be all hands-on deck to help private facilities succeed. There is experience and expertise in the private sector. Help from the public sector should be delivered in a timely fashion because public funding helps private sector achieve its objectives.

Question: Does the public get enough out of this funding? We need to avoid putting in projects that are not critical.

Comment: Josh showed a slide about Element 2 about developing an annual public solicitation for public researchers to conduct studies in companies. They can achieve research-grade plasma. Need to change and propagate rules for appropriate time scales.

Comment: Look at university rules – rule changes may lead to conflict of interests. Different impediments occur with national labs but must look at the whole big picture.

Question: Can you briefly explain how it is a conflict of interest?

Comment: If I take DOE funds to work in a private company, I am not actually serving the purpose of a public company. But if you look at rules at Columbia University and maybe other universities, INFUSE would not have happened.

Comment: DOE funding is very constrained. Rules would have to be changed and negotiated with the university.

Charge Question 11: What are the preferred methods of assuring mutual research interest of public and private entities? Should private company topical interest statements be included in the solicitation? At the proposal level, are Records of Discussion (RoD) sufficient?
Record of discussion: If you specify what should be in it and there is open, clear communication.

Comment: It should also contain regular touchpoints.

Comment: Use it as an open channel for communication.

Comment: At Sandia National Laboratories with the National Nuclear Security Administration (NNSA), we use a formal Request for Information (RFI) that could interest both private-public relationships. Key questions can help structure a program.

Comment: I talked with INFUSE about how to better match PIs from the different national labs with the private sector. Private companies can put out what they need and have the national labs reach out. Before, we were trying to get contracts with the national labs and now national labs are trying to get contracts with us. It would also be nice to vet applications; what we want and do not want. Matchmaking is needed if we have a critical need and do not want to wait for 2 years before a project is funded.

Comment: A table of expertise may also improve efficiency of public-private partnerships.

Comment: RoD is a good process. I have been through many of them, and it scales to the private side as well. I think they will work.

Comment: Private solicits a particular expertise. Open community should listen and accelerate to the scale of the private sector. Public sector takes too long to meet the requirements of private.

Comment: Topical interests may not be good for a private company, because they have other priorities. And the public funds may not be there and if private needs you quickly it is difficult for public to mobilize.

Comment: Formality and structure are necessary. Sometimes you are talking to the wrong people in a RoD. A letter of intent may be more formal. Management makes decision and must be informed so decisions are not made out of the blue. Hopefully this gets better.

Comment: In the private sector, processes exist and instead of creating something new, improve on what is there. Public side should be more educated in this.

Charge Question 12: In addition to required Promoting Inclusive and Equitable Research (PIER) plans (https://science.osti.gov/grants/Applicant-andAwardee-Resources/PIER-Plans), are there any unique features that could be added to a PFR program solicitation to improve diversity, equity, inclusion, and accessibility?

Comment: Diversity, Equity, Inclusion, & Accessibility (DEIA) initiatives in some companies are better in companies than they are in academia.

Comment: DOE can make use of list catalogs and directories that can help break the old point network and to help teams identify diverse collaborations.

Group C, Element 3 (Private run-time modalities)

Charge Question 13: What are the possible modalities for providing FES support for private facility operations for public researcher experimentation? DOE's Office of Nuclear Energy engages in a reimbursement model with private companies through their NSUF program. Could similar models be applicable to this PFR program? What other programs could serve as a model?

Question: There's a reimbursement model through the NSUF, so one of the specific questions is how the NSUF model seems, and what other programs could serve as a model?

Question: Has it been stated whether we will go and get separate funding from this to work on these facilities or are we talking about funding research at a company's facility? In other words, is this to support you when you have another grant or is this the grant?

Comment: This is funding for the research, not just an FOA to support individual research – some resources should be in place for private facilities to accept users.

Comment: The specific NSUF model would be useful when we have more facilities that are translational and useful for discrete tasks and smaller-scale tests, particularly in cases where there is equipment that public entities wanted to purchase but did not see 100% utility in. ST40 and the Scholarly Publishing and Academic Resources Coalition (SPARC) are examples of research-oriented programs rather than transactional. Once SPARC is going and stable, something like a fee for use with runtime that maybe looks more like Medium-Sized Tokamak-1 (MST-1) may be appropriate.

Question: With NSUF reimbursement, what did that look like? Were organizations reimbursed for time and equipment use? What are the criteria for reimbursement?

Comment: The funding included funds to get the data, analyze the data, publish the papers, go over there, run experiments. Let's say ST40 – we are doing our work within the framework. But then at some point those internal files are satisfied and there is a machine fitting there. The question is whether the reimbursement may be more effective. And the U.S. paid for runtime and to do our own experiments that may not address the internal milestones of ST40, which is basic research. And we basically pay for runtime. So, there are two ways of funding this.

Question: Is there any hardware provision included in NSUF funding? I do not know how this works specifically for the NSUF program, but generally at universities, you have a facility for doing materials characterization-type work. That facility will set rates per piece of equipment for users and then there is additional costs, if you require assistance from one of the experts who's there in charge of the equipment.

Question: For instance, when you are mentioning the university model or a private company, maybe you can talk better to this. If we do not have downtime, how do you prioritize or allocate time? Based on either a fixed structure of number of hours per year or an as requested time basis to be able to leverage time?

Comment & Question: Yes, there is a cost benefit for allowing research to happen and then be not discuss what happens with the IP – that is the longer discussion, but how do you allocate time for that?

Comment: You allocate time based on what you want to do. We are testing and we have a collaboration with DOE; it could be either we are going to allow them to do a hundred hours or spend a certain amount for the year. I think the natural way of working is through a proposal system on the facility; they say, “I want to do this experiment. I need 21 good shots. I complete the experiment. I can get by with a dozen, but ideally, I'd like 21 shots, so whatever that takes”. That might take two days of operation. The person doing the experiment, the collaborator must sort of be flexible what the machine can do, and what the other stresses and pressures are for runtime. But also, the facility has to be flexible. Some guy has flown in from the U.S. for a couple of days and wants to complete his experiment. That’s what happened when I ran on ST40. We expected this to be a day and a half experiment. It extended to two and a half days. I might ask a grouping question which is like in the way we normally do this it's scientific merit allocation by a little bit semi-external group, maybe to the private participants.

Question: Do you foresee just copy-pasting? Would there be a little bit of a mission-driven attachment to that, or would it be a purely outside science, with the runtime sold daily and the facility doing controls it. Or would there be some more of a collaboration?

Question: I think there is a question behind this which is what is really the mode of engagement here? Are the users just consumers? For DIII-D, we have the Frontier Science Campaign, for people totally unfamiliar and they come to the facility, and they get a Rolls Royce service, which means a huge amount of staff resources support those people and hold some through an experiment. Is that a drain on resources or is it shared? A provision of the machine? We have University of Wisconsin providing diagnostics, that part of the team. You have people providing physics operation measurements and so on. That's very different models and it has a very different impact on the private company that is or whoever the host is.

Comment: It depends on the complexity of the experiment, not all of them may require the same level of detail. Maybe Wisconsin has different diagnostic capabilities than another organization may have, and we need that for the data. Are the users part of the team providing, or are they consumers? These are very different perspectives.

Comment: There's a good model here, like the wind tunnels Lockheed Martin has split to do all their development on. They let other companies come in and do time on it and there is a planning process who gets in, when, and how long.

Comment: That's a light source model and very often when we in talk about physics, we say that it doesn't work for us because providing a tokamak is an integrated activity. You need 50 people to make an experiment work, so you cannot just turn up and do your thing in isolation; you need 30 people actively helping you who may be charging to different grants and so on.

Comment: You come in as the customer, you are at the customer room. Like you say, I want to do these shots over this day and there is a cost per hour to run the tunnel. You get charged. If something goes wrong, you are not getting charged. There's an example you could pull from that like how to run a facility like that. With ST40, did you feel like a consumer or like a member of the team? I felt like a team member, and I think that is what works best is when there is mutual benefit between the collaborator and the private facility. Where the bifurcation comes in. Is that if I came in and I wanted to do a space plasma physics experiment, which is totally divorced from whatever the ST40 internal milestones or that is with reimbursement model made.

Question: When it comes to ST40 – would it be worth bringing in the government-funded people to help solve this problem?

Comment: The difference there is the ST40 researchers were not as experienced as the people CFS has.

Question: Question for the private companies, when we use this reimbursement model, what are we buying? What is the private company providing? Will the public institutions have to pay all the energy and personnel costs for each experiment, or will the facility cover some of that?

Comment: They would provide you with a data processing agreement demonstrating what the cost is for time, etc.

Comment: There would have to be a negotiation ahead of time to establish cost structures.

Comment: Cost sharing for a project for which the facility will not own the intellectual property is a tough sell.

Comment: If it's government-funded, all the IP stays in the public domain, that is generally the rule.

Question: What is the return for the company? Is cost sharing even appropriate here?

Comment: Materials research, tritium blanket research, that seems very well suited for renting time on an existing fusion reactor and then doing that material science time and blanket testing time.

Question: What are we buying and what is the private company providing? So, in other words, would the public institutions have to pay all the energy and personnel costs within 3 days of experiments?

Comment: In-kind contributions may replace the more traditional pay-to-play model. It's going to be a sliding scale where it will cost the government more for things that are farther from the business and mission goals. One challenge with in-kind contribution of hardware is we need to do things more internally for safety.

Comment: You only seem to be able to determine the costs to sustain instrumentation after the DOE has given the award, which is another challenge.

Comment: We must do things internally because of safety and engineering. When we funded diagnostics on DIII-D, there was money set aside to help interface and engage, similar to last mile costs. We are going to incur those costs with our staff and hardware; any additional money that comes through from DOE will be for used for safety and technical reasons.

Comment: How do Cooperative Research and Development Agreements (CRADAs) enter the project? There needs to be an agreed-upon CRADA where the labs are aware of the expected level of participation. CRADAs are also time-consuming, taking years to establish. Part of the challenge is the lots of parts of DOE. There's FES and then there is each of the site offices at the 17 DOE labs and they are all different. And then there is each of the site offices at the 17 DOE labs and they are all different.

Comment: It would be nice to have blanket agreements, which can be made more quickly – maybe a generic memorandum of understanding.

Charge Question 14: Understanding the uniqueness of each facility, are there any general principles that should be applied to determining experimental 'ownership' of a research project?

Question: It seems like the business model for a private company is very different from the traditional research model doing science and running a facility. I'm not sure these companies want to be owners of a facility they are renting out – they want to move on to something new. So, is building what you want and getting out of it an appealing option for companies?

Comment: Yes, I see that as cost recovery for the company.

Comment: Others mentioned several facilities developed as user facilities including Marvel at Colorado State.

Question: What about ownership of physics topics in the embedded model? What is missing in the ownership model? We strongly emphasize the direction it needs to go. What would be different about something that CFS would just fund itself, and what would be different if the government money would come in to direct something? I think we would interact with it differently than if the government money would come in to direct, if there is money going out the door to support something.

Comment: From the academic perspective, publishing is important and should be considered part of the deliverable.

Comment: Publication with CFS has been easier because publication is not central to the function of the private company as compared to a DOE host facility, where publication is vital and there is increased competition. Public participation and publication were welcomed.

Comment: The mission evolves and changes a lot faster with the private industry than it does with public, but I think that is a good thing. The idea is to check these milestones off and then move on to the next one.

Comment: From my view, the light source model and the embedded model are really different ways to do research. Working at a university, it's your experiment in some sense.

Question: What fraction of operational private facility time would be made available? How does this evolve? How did it evolve as an example, at ST40?

Comment: There was a lot of piggybacking initially and when the capabilities evolved and matured, the experiments depended on the device capabilities and diagnostic availability. Being able to achieve plasmas that were somewhat stable and could be pulse lengths as long as possible. We did have only one experiment that that was run on ST with a lot of piggybacking.

Comment: Private facilities may have to bar publication of certain findings, particularly if it is being funded internally and has been assigned to someone internal to the organization. For example, troubleshooting or incidental findings may fall out of scope of the initial contract.

Charge Question 15: What fraction of operational private facility time could be available for public researchers? How might this availability evolve as company milestones are reached? To what extent can 'piggyback' experiments be used?

Question: Are there other facilities that are necessary for fusion that are not being focused on?

Comment: Westinghouse has hot cell as an example.

Comment: I wonder if a different mechanism than an FOA is needed because the government ultimately doesn't control these facilities. These are not user facilities that the DOE owns. INFUSE has used the Request for Assistance (RFA) mechanism, which I understand to be more flexible. There's the other mechanism that has used for the Milestone-Based Fusion Development Program. I think it's public.

Question: There is two things here. There's non-fusion in privates and then there is non-fusion plasma. So, for non-fusion plasma, that is very much outside of the mission of the facilities, right?

Comment: That would be interesting; cost recovery needs to be a lot higher for that. I would think it would be a challenge enough that if you opened up an FOA about it, you probably get a lot of private companies not being interested because it might be too far out of line. These are all very non-aligned activities. What would it take for a company to use its resource on it?

Question: Is piggybacking enough? Depends on capabilities and whether dedicated experiments support company milestones.

Comment: Investors need to see the value of piggybacking, post-milestone cost recovery.

Comment: Ownership of publication rights needs to be considered and delineated.

Comment: Okay, I'll just note there is another local example. Here at PPPL, there are some machines that were brought in recently. I think for producing diamonds it is commercial equipment being re-tuned to use a different feedstock for that material. I think that would be a similar type of thing.

Subcommittee Breakout #2

Group C, Element 1 (Data Repositories)

Charge Question 1: Discuss the partitioning of proprietary and non-proprietary data and the sharing of nonproprietary data with publicly sponsored PFR program collaborators.

Question: Did ST40 make all its data available and how was that defined – was there proprietary information?

Comment: All their proprietary information was in the magnet from CFS, so that was an entirely separate program. The experimental data was not proprietary.

Question: Are there corporations who would consider the plasma data proprietary?

Comment: I think for a lot of these machines the startup and getting the plasma machines running is the secret, proprietary information but once you are at steady state conditions, less so. Probably time and instrument bounded.

Comment: NDA secret in this case.

Comment: Diagnostic data is publicly available but if you need company resources to process the data, it would be proprietary.

Comment: On ST40, a private corporation may have the right of first refusal for research topics and whether that data would be public.

Comment: Whether all shots would be available is another question.

Question: Will users be given inclusive or exclusive access?

Comment: This depends on the corporation.

Comment: Databases will have flags to prevent users from accessing privileged information.

Comment: All the data for SPARC outside of those who bring new instrumentation would be proprietary where the rights are held long-term. Proprietary vs access are different discussions. On segmented access, the things needed to contextualize like plasma troubleshooting should be accessible, but for example plant operation would not be accessible. And access is not a guarantee of the right to publish.

Comment: Internally, what is open and what is limited – specific scope for a specific type of subject. Certain users having access to different subsets based upon project scope.

Comment: By tokamak may be the easiest to segregate – most people will not have interest in the plasma development itself as it is already well-established.

Comment: Disruptions, unique parameter states for disruptions, these things will be entered into a database – it would be unlikely one observed phenomenon would be fully extrapolated to the next concept.

Comment: Protecting database structures, IT in general, the use of Artificial Intelligence (AI), are all things that may be considered essential by the companies.

Comment: The science of certain code working should be peer-reviewed to enhance the confidence of it, as it is still science.

Comment: All these boundary conditions need to be defined before investment.

Charge Question 2: The regular (e.g., daily) mirroring of non-proprietary private facility data to a centralized public repository both protects public collaborative research investments and preserves essential data for both public and private benefit, but it is not intended to be the primary data access point. What criteria could warrant public researcher use of data stored in a repository (e.g., in case of company bankruptcy)?

Comment: Mirroring of data in the cloud may allow for scientists to discover proprietary information using only public data as this is their area of expertise. As a private company, it may be concerning to send data to DOE-owned facilities for storage despite retention of legal rights to

the data. This is again another situation where legal rights and access are entirely separate and must be considered as such.

Comment: There may be a way to provide access and rights to public partners outside of traditional public repositories.

Comment: Should the company decide to disengage or go bankrupt, they may sell the data as part of cost recovery to another institution, public or private. Data is also a product with a certain level of value.

Question: Would processing codes go into the public repositories? Will there be knowledge transfer? Will the data be FAIR? Absent sufficient metadata, the data would be absent of value.

Comment: Experimental Advanced Superconducting Tokamak (EAST) data transfer to General Atomics allowed for fast computational interaction with data. Similar interactions are observed between Korea Superconducting Tokamak Advanced Research (KSTAR) and PPPL.

Question: Does the company have the right to the data held on its own server – or is it government owned at this point?

Comment: If we are moving into the operation of nuclear devices and generation of nuclear data, there is a question of security when sharing is considered.

Comment: Tritium technology is another issue where sharing is concerned. There are other dual-use technologies as well, but the U.S. tends to set export control boundaries. These points were not brought up for discussion, but it would be recorded that these are pertinent issues.

Comment: Is data storage technology part of knowledge base? Assisting in data storage and access may or may not be within the FOA scope.

Charge Question 3: Are there alternatives to data repositories that achieve the same protections?

Comment: Local storage an option.

Comment: Thinking of the data as files is too narrow of a view. These are stored quantities.

Comment: The goal of this question appears to be to examine ways to secure data for the long-term.

Comment: Making sure there is a way to track and get robust logging of access to this data. Export control and cyber security are all qualities that data repositories would need for this purpose.

Comment: The aim should be not to create unnecessary work for people. There can be a legal agreement up front by having the private facility demonstrate the previously mentioned qualities and plans for the event the company can no longer support the storage mechanisms discussed in the contract.

Comment: DOE requires that data in publications now needs to be provided and machine readable.

Comment: MIT has a previous agreement to secure the Alcator C Modified (C-Mod) tokamak data. They are storing, maintaining and providing the software to access the data.

Comment: Grant applications require a data storage plan, but there is not time frame outside of the grant funding period required. Theoretically, once the grant period is over, the data is no longer of concern.

Comment: TFTR data, as an example, was on historic infrastructure. Some of the data was retrievable, some was not. Maintaining data with constantly evolving software is costly.

Comment: Public repositories may be a safer bet to store data at a lower cost to the private research facility, and it would be in the public domain in perpetuity.

Charge Question 4: The establishment and maintenance of data repositories is non-trivial. Discuss anticipated public and private levels of effort. Should private company costs for establishing public data repositories be supported by FES?

Comment: It seems puzzling to ask the private institution to fund a second data repository, when they are likely to make their own, with backup. It would not be public, however.

Comment: The question is asking who should have to pay for long-term data access and storage.

Comment: There is an assumption that the public program accesses the public database rather than that provided by the private entity, which is an assumption it may not be appropriate to make.

Comment: Telescope data was presented as an example as it enters the public domain automatically after a certain time period has passed.

Comment: C-Mod and other institutions require roughly two full-time equivalents (FTEs) to keep their data repository going. But the people accessing this data likely already know what it means, and how to use it. The cost of keeping the data useable after the lifespan of the company may be greater to ensure its value is maintained. CFS has a software team to this end, but it is merely a part of their scope which includes broader test data.

Comment: A person can be assigned to help make the data accessible, but as mentioned previously, requires FTEs.

Comment: Model Driven System plus (MDSplus) is an exemplar, it is a shared tool, which has some benefit because several institutions use it and had a role in its development. It is an informal agreement, and the global community uses it, finds bugs, and contributes to it. There is, however, no capital cost.

Comment: There are also significant hardware costs for the storage of newer data, and IT costs for those responsible for the maintenance of data centers.

Comment: The people employed in these tasks are likely employed within the companies themselves as they have the institutional knowledge of the data and its storage requirements.

Comment: The International Thermonuclear Experimental Reactor (ITER) Integrated Modelling and Analysis Suite (IMAS) may help alleviate some of the understandability issues with stored data but cannot be a panacea for all data – particularly stellarator data.

Comment: There is also a question of data structures and how consistent they are across fields.

Comment: Digital twins may offer some solutions to these issues as well, but these solutions are not built for the long term.

Charge Question 5: Is there private company interest in mirroring their data to a public repository even in the absence of an initial public collaborative research effort?

Comment: No – there are commercial tools that do this. Amazon Web Service (AWS), etc.

Question: Who would pay in this scenario?

Comment: Some private data are on GitHub already.

Comment: The question could be "Do private companies want someone to provide this service for free?" as most of the paid services are expensive, due to the number of redundancies to ensure data is not lost.

Question: When doing data mirroring, will there be a way to standardize the data from different devices? It would help science to have these data available in understandable formats available to others.

Comment: When it's compliance-driven, it becomes a burden, but should private companies feel FAIR principles are in their own self-interest, they will be adopted.

Group A, Element 2 (Solicitation)

Comment: Back in the Community Planning Process (CPP), there was a statement made that DOE didn't want to collaborate on plasmas that didn't exist. If that is the policy, then you are going to miss a lot of opportunities. For instance, CFS is a private company, and their diagnostics focus mainly on mission validation and protection. It would be nice to have higher resolution diagnostics that could allow us to do plasma physics studies. You might miss opportunities to exploit that to the fullest. Updates to some of the plan diagnostics and more comprehensive model validation would be good. Hard to put that in later. There's sort of a balance that needs to be struck. Balance the risk versus the reward. If you do not engage early enough, then you do not have the measurements that you would like. How are we going to collaborate?

Comment: Agree. We recognize the different time scales associated with the facilities. In the case of ST40, they were moving into their facility. We had a big shift in mindset. Engagement came later, but there is a certain time period for implementing these diagnostics. It has to precede the actual plasmas themselves or they are lost.

Comment: There is a certain amount of risk government has to assume.

Comment: In international collaborations, we have a partner that was mostly working with us. There was a person at the collaborative institution that had full ability to use diagnostics and full ownership. Protections for the collaborator? What happens if funding or I disappear, or get a different job, etc.? Works really well with a partner that has full joint ownership. We should encourage this here as well because it is good for both parties.

Comment: From the company's point of view, they have processes and procedures, and they will want to manage the facility a certain way. We have sat down and talked through the "why".

Comment: With RoD, we can elaborate with technical people on both sides.

Comment: A national collaboration setup, a record of the plan to research goals for the device. Proposals were solicited. Without that list of research goals, proposals guaranteed to be unresponsive to the machine's needs. Identifying those research goals as early as possible and including that in the solicitation is important. There's the STX example. Process there needs to be thought through. Research goals of the device are different from the SC goals.

Comment: Soliciting different kinds of companies, their missions and their physics objectives absolutely could and should be part of an FOA or solicitation.

Comment: Seek to engage the public program early. Think bigger about capabilities. Is there a way the public program can engage early enough in the process so that we can actually bring in the capability or design required? Frame solicitation in a way to maximize the win-win

instead of a private company paying for the device. Bring in the diagnostics and also the capability we really need for the research program.

Comment: The goal is different as a company. Not interested in building diagnostics. The person learning diagnostics do not want to give that secret to anybody else. Need another person in the company that can operate that. We want to operate that diagnostic as much as possible. 24/7 if possible. One person from company operates that, but then the problem is that the person who owns the diagnostic has hesitation in sharing openly. Both sides need to understand, we are not interested in diagnostics. We are just going to use the diagnostic. Build trust on each other and go from there.

Comment: Early enrollment and possibly affecting the machine design is a good point. Those conversation should happen. They are expensive machines, and we should make them open.

Comment: How can we effectively deliver those research objectives and involve research plans? Proposals were somewhat more general. Renegotiated the milestones and it is more of a living document than what people are used to. As CFS interest changes, we have discussion and if it is mutual interest, we might modify the milestones in the contract. That flexibility is needed. Can't take a year to change the scope of the contract.

Comment: Picking up on capability comments, we are used to having this conversation around existing machines. That's not how machines start. It doesn't work to start. The capability you need is the people who have seen it before and trust each other and can have an open dialogue. That's the value of the public program. Whatever structure we have, we need to be able to foster that. It can be that it works, and you get the payoff of the physics later. Need to facilitate that. We need something here with that level of embeddedness, that level of collaboration.

Comment: A long-term relationship is important to infuse in this. A longer-term program is more valuable because you build relationships, enable graduate students, and more scientific developments. Long term contracts are more valuable.

Comment: Agree with long duration and building mutual benefit, although on the solicitation we are still in competitive research based on merit. There is a tension of when it comes to evaluation of proposals. On the public side of things, there is no framework for flexibility built in. The framework should address productivity, flexibility, and agility. There is no review right now in any of our solicitations like this. How do we competitively evaluate this?

Question: Any ideas how to do this? In essence, you are the community.

Comment: Enable scientists from the public side to take on leadership in the private side. Get a different perspective. Works in international collaborations. We do not have a huge influence because we are one part of the large collaboration and not sure how to put in there the part of our role as a leadership role.

Comment: Common theme is to establish a team of internal team plus external people. Separate commissioning phase for one or 2 years by the new machines where you just have the different merit review criteria.

Comment: Given a number of variables, not sure how all of those get grown together into a single pot at the beginning of any sort of collaboration. The private company foresees that there is some sort of IP generated. Be proactive and start with whatever legal process that might be necessary.

Comment: Diversity, equity, and inclusion. Building teams and agreement. There is an inherent tension in these programs to make sure that everybody has access in principle to apply and to contribute something to the facilities. Just pointing out the tension. Needs broad

engagement. Point of contact with people that are interest could be created. Initiate the discussion or make it available to everybody in the publicly funded program.

Comment: Site access. Eligibility. Tokamak Energy. National lab to seek capabilities domestically first.

Comment: Going to a private facility, it will have a wide range of people at it. It is up to the company to figure out how to manage it. It is not that dissimilar to going to an international facility. Engage in a review. We do not have to reinvent the wheel of how it works on the ground. It is more of a mixing pot.

Comment: Site access. You are most effective when you are on site. Tokomak sees this as something we are interested in. Bring people to our site. Trying to develop the trust and ability to come on site is important. Not random access, but you need to be funded to come on site. Doesn't mean they can walk through the whole facility. Come on site in certain areas, but not others, like national labs. I do not see the issue here. My card doesn't work on all doors. Should be the same for all collaborators.

Comment: Timing of solicitations. Longevity and relationships. Facilities driven. Three years is too short. Might be good for modeling exercise. Something longer than 3 years. When you are doing hands on hardware work, having to review things every 3 years is tedious. Consider the length here. I do not know the answer, 5 years.

Comment: SC requires 5-year review.

Comment: At least 5 years to hire a graduate. 6 years from reaching out until graduation of the candidate. I'm trying to kind of streamline a path to PhD. Funding continuity also helps on the university side.

Comment: Site access. Most companies allow visitors to walk through area. We are actually talking about a person being on site for an extended period of time and working in the lab and other things which are proprietary. Someone can look at diagnostic data, and there is no way I can go cover the screen of other people. I think that data is proprietary data and is protected.

Comment: This is important point. MIT agreement is an example. I have right to go to MIT and wander around quite broadly. If I wander into someone's research lab and I contribute to a discussion, I do not get to have ownership in that IP because I was not funded to do that research. We get access to see something with the right to do something with what we saw but we do not have the right to publish on that. We need to get past that surface level that we saw something and then we can publish on it. You cannot publish it.

Comment: Should not be expected to be allowed to publish it if you are not there to do it. Right of ownership of first discovery is different in private sector than in general public research. Mentality question. We need to set the framework around it building a team and mutual understanding and providing the flexibility needed.

Comment: Real value infliction is in building the product and turning it on and not actually running it for years to come. When it comes to staffing and maintaining that facility, that is something that needs to be considered. Proposal would need to allow for flexibility and for delays on the critical path.

Comment: What makes a good proposal and solicitation? How close to the critical path is it? Expectation of people working on critical path is going to be different from putting a student versus collaborator on the critical path. Interesting but not so important. Find middle ground. Expectations can be mix matched.

Comment: An RoD period is one method. If there is feasibility, then we will decide. The private companies need ownership in this. Do not sign a RoD.

Comment: Too close to critical path. As a collaborator, part of my career is to publish regularly. Researcher needs to pause to write paper because it is important to career. Find the middle ground for both company goals and collaborators.

Comment: Example of Devens stopping to help with operation which happened to be critical path, versus expectation that he would then ultimately deliver some science on the critical path.

Question: How does this framework fit in with public involvement and device beyond the point that the public or private company is interested? How is it when the experiment is no longer active? Can we come in?

Question: How open are facilities when they have this great new capability? The broader publicly funded program that extend beyond that, i.e., long term operation, validating code, and enhance everyone's long-term mission beyond what the private company wanted to do.

Charge Question 9: To ensure both depth and breadth of fusion research within the PFR program solicitation, a tiered system based on $nT\tau$ is being considered. Discuss options for such a tiered system. How should non-fusion efforts be weighted?

Question: How are you envisioning that work? Do you take company's word for what they are going to be? Is this a trustworthy projection?

Comment: Concept has a given end point documented in peer review.

Comment: What do you want to get out of the program? You have to put a lot of research and effort into the next incremental result. If you are looking for a metric, you need to be clear on why.

Comment: Plasma physics can be done, but other research can be done on these machines, too. Private facility research is broader than just plasma diagnostic, i.e., actuators. In a solicitation, it is worth thinking about what other types of research you could do on a private facility.

Comment: This program is intended to be science and technology.

Comment: Trying to understand how the IP would work in an embargo period. If it is going into a public repository, how does that embargo period work alongside FOIA requests of folks who are outside the scientific community? Does it exist in the public domain?

Comment: Public researchers, lab employees, what are your biggest worries and what can we do to allay that?

Comment: On grad student research building a diagnostic which might take longer for them to bring something to publication. Different kinds of researchers might try to scoop it more quickly than university researchers.

Comment: National lab concerns.

Comment: Good to have a timeline of any review process. It's not that we are totally inflexible but feedback in a month or a period of time is difficult. Biggest worry is that I do not know if I will be able to publish a paper on research I've agreed to do.

Comment: The pace of thing is quicker, and response is not that fast in National labs. Managing that uncertainty takes effort at the national labs.

Comment: Question of respect between public and private research programs. They respect different time scales. To foster public private engagement, it is counterproductive to build long term relationship if they are not continuous or why are we still here.

Comment: All these questions are written for public sector scientists and public sector scientists, and they do not frame the solicitation. That's really DOE. How can DOE help frame solicitations?

Comment: Intention here is to gather input that would ultimately serve us in developing an ultimate solicitation.

Comment: It's all from the point of view of the scientists.

Comment: We all have strengths in this together and should be playing off our strengths finding where Universities do the best, what national labs and industry do best, and weaving it together.

Comment: We would like to engage significant teams of researchers, have an impact and a relatively long-term constant collaboration, and have clear communication around open research and what is IP and what is out of bounds. Some degree of agreement upfront for what is proprietary.

Comment: Solicitation process. Who is applying? Record of discussion to the company or ask the company to apply alongside the publicly funded researcher. As you structure this, make it a teaming sort of solicitation. There is a Diversity, Equity, & Inclusion (DEI) issue with that. One way to force these solicitations is by putting it into the solicitation. Second. The milestone program. They asked questions as part of the competitive solicitation that I have never seen DOE ask. You might find people who know how to collaborate and can review those types of questions.

Comment: Concern about when a company pivots away from the public program research. And another concern is when they move toward it and decide that that is the way to do it and they want to do it now and not over a period of time of a public program.

Comment: If a private company engages with a public sector person, they chose to pivot.

Comment: How do you ensure that the public research still stays relevant.

Comment: For mutual benefit, you do not want to move the same people around and stir the pot. On the other hand, you have goals and a program set and you have involved characters that move around and change their lives and are more flexible and how can we fold that in. Flexibility.

Comment: How different types of organizations are good at different things. Do not lose this. A startup is a temporary organization for a business model. There will always be some risk that they will just decide to do something else, and they will never constrain that ability. That's part of the risk and the benefit of that type of organization because they are not institutional and will not behave the same and we will not want them to. There are limits on what you can ask them to.

Comment: People moving between those companies is an important point. There should be some kind of protection like a time limit.

Comment: Graduate student time scale benefit.

Comment: Not every company can sign up for a 5-year contract. Having some flexibility and long-term collaborations are both valuable.

Comment: Team approach rather than individual researchers and their agreements and how that can ultimately be useful impact to these collaborations.

Comment: Things being out of bounds upfront and have clear communication and expectations upfront.

Comment: Have a backup plan in case things change. Something malleable.

Comment: I'm confused by what "team" means in this.

Comment: Having one person from the public side and the other who is operating on the private side and making sure there is a strong counterpart.

Question: Should this be part of the solicitation or is this best practice?

Comment: The earlier that this program happens the more valuable it is. Coming up with a new legal framework might not be advantageous. Maybe use the existing framework to do it faster.

Comment: Engaging in early diagnostic deployment there is a greater potential impact in the future.

Comment: Should there be a RoD on the facility side versus should the facility owner co-apply. Two ways to structure it.

Comment: Keep the facilities' owner's thumb off of it. That might be too much pressure for the public program to really have a good broad impact portfolio. You do not want the facility to pre-select too narrow which would be a detriment to the creativity and create a new barrier for new people to the field or to the relationship.

Question: In case we are not controlling the facility, we look at this as a facet where we support an activity that isn't ultimately support by the private facility. How do we say that the facility has to do it?

Comment: I'm worried about getting too few submissions if the facility is co-applying.

Comment: In that respect you are right. The notion of co-applying is a difficult one, but the notion of looking at simply these records of discussion and commenting on those, is a low barrier to entry.

Comment: Is there a way to do this on the preproposal stage and make it mandatory for the pre-applications to get the facilities involved and avoid overbooking problem.

Comment: Capability teams that are agnostic to particular facilities. Teams where you have a group of experts who say we can do something and that is part of what gets funded or multiple facilities.

Comment: Teams. One person, one effort can do great stuff and the notion that this has to be a big multiple team effort.

Comment: Good part that every company is slightly different, and that the common facility was already there. People will propose based on which facilities will give you the best. This program is more diverse. Negative side, you are asking companies to open their plasmas and be checked by DOE representative, be compared with each other, and check on your device.

Comment: We are not making a tool which companies may feel is becoming something which is putting them in comparison without their control or input.

Comment: Are you thinking of adding enablers such as engineers to enable the science or focused on the science?

Comment: Intent is to sort broad participation. Initially it was narrow, and we wanted to involve other people including engineers. There are sensitivities there.

Comment: One thing that could be useful is placement of technicians from the public sector. Where there are no longer experiments being done, it could be useful to house them for a few years or for the length of the project at the public company.

Comment: The idea of having experienced people around not just for science but for the experience of how these facilities operate.

Comment: Encourage having some DEI.

Question: We have PIER plans but what else?

Comment: How to make a solicitation where it is possible for people to contribute their ideas and feel being heard. This does not mean that you get funded. How do you ensure that there equitable sharing and have a RoD so that there is no winner being picked beforehand. They have to at least listen.

Question: How closely does DOE development solicitations?

Comment: Engage the private industry to provide mission level statements for their research objects at the facility. The primary focus of that in a given period in addition to knowledge that they would consider non-proprietary.

Comment: Having the companies apply. There might be utility to having a two-part solicitation or first you pick companies that you want to work with and then you identify companies where you have research plans outlined, and then put out a solicitation for applications for public sector researchers, the selection of both the company and the researchers.

Virtual Attendees, Element 2 (Solicitation)

Charge Question 6: A fundamental tenet of the PFR program is the freedom of public sector researchers to publish experimental results from private facilities. Identify sensitivities and paths for resolving them (e.g., 1 mo. publication embargo for private company courtesy review).

Comment: It is absolutely essential for university researchers and publicly funded researchers to have the right to publish. It is a necessity, but also an example. We at MIT have done this successfully for 6 years with CFS, including on highly sensitive information. Even some negative projections have been published by MIT researchers. There is the language for these agreements out here. A short delay can be requested in order to patent. I've never heard of someone having an onerous delay or not being able to publish what they wanted. Yes, it is important, yes it can be done, and in practice it should not be a problem as long as the right language is in the agreements to start.

Comment: The review process by the company is important, and researchers should not be publishing from a database without discussing with the people they took the data from. Perhaps there can be a review process with DOE. I think the review process is important to list.

Comment (via chat): Being integrated into the team is the best way for many cases, though for certain simulation work where a code developer extends code capabilities in a large computer code, it is more important to have a liaison who ensures the quality of the data for that particular study. A computational physicist may not need to be fully integrated into the team but should never use data without close contacts who know the data. For charge question six, there should be an option for the company (and maybe the public sector researchers) to extend the embargo if needed beyond one month, though not indefinitely. One month is a bit short to complete many types of analysis that go into a given conclusion and may not coordinate with private company milestones, etc. There could be a standard maximum time if the initial period is extended (for good reason).

Comment: This is the fundamental tenet and is absolutely critical for publicly funded researchers. A short review process for publications should be agreed on. We also recognize the value of the review process and encourage it.

Comment: This could almost be the fundamental tenet; the whole point is to publish for the public good.

Comment: There is positive experience and good examples for this. There is a fear that this is going to be very hard, and I do not think the fear is justified.

Comment: Perhaps there could be a template for those private companies engaging with publicly funded researchers. This could shorten the lead time to establishing collaboration.

Charge Question 7: Public sector experimental collaborators are expected to have an appreciable on-site presence at the private facilities (e.g., those contributing diagnostics and other hardware). Discuss preferred paths for site access, safety, and data access?

Comment: I think this comes back to the comment that having a visiting appointment is one mechanism to clarify site assess, safety, and data access.

Comment: To be particularly productive and good contributors, you need to be integrated with the group you are collaborating with.

Comment: On-site presence for extended periods is going to be important, especially if this is going to be relevant to diagnostics. I have a lot of collaborations which do not always have an on-site presence. Inclusion does not require permanent onsite access, but it does mean visits, inclusion in meetings or research groups, or good communication. Data access can be done remotely at some points. More than physical, what mechanisms do we set up for good collaborations and communications (such as guidelines and expectations)? You do not want a publication to surprise a company because it was never communicated. JP Allain said this nicely by stating "trust, honesty, openness, inclusion" were necessary to do this.

Comment: My experience is that you need to be an integral part of the team; so that while you are there you are not just doing your own work but are contributing to the goals of the facility and those around you. Collaborators integrated as part of the team is my preferred path, and if you are integrated you are given safety lectures, certifications, and data access. Becoming an integrated part of the team if possible is key.

Comment: You need to be integral part of the team, which requires openness active inclusion in the larger team and contribute to the goals of the facility.

Comment: We have many staff which operate remotely, and safety is always an issue. We generally do not worry about DOE sites since there is a consistency about safety culture, but private companies are very different and have different levels of control. Safety will be case-by-case and may depend on state laws. It may be necessary for the home institution to have a safety presence or monitor for safety. Universities do not necessarily have all the resources to investigate every fusion company.

Comment: I think we have to flag this as a potential issue, and it may vary depending on state laws. This has been a huge issue in dealing with some international collaborations. I've worked with international collaborations were there was no safety culture, and in the United States it is varied. Occupational Safety and Health Administration (OSHA) is the standard, but that does not mean people follow it.

Comment: I have certificates on file with the University of Wisconsin, and y collaborators must provide certificates of insurance. It may be conceivable for people who are collaborating with other facilities to require something similar, and to be aware of that need before the collaboration starts may be advantageous. Can DOE facilitate various types of collaborations? Can DOE/FES/SC reach out to these various institutions and come up with some sort of umbrella agreement regarding liability, safety, and the like so that other institutions do not have to reinvent the wheel.

Comment: The collaborators need to be an integral part of the team, which requires openness, active inclusion in the larger team, and contribution to the goals of the facility.

Comment: One exception is that sometimes you do not always need to be integrated into the team, but sometimes you can have a liaison.

Comment: I push back on that; I think it is in the best interests of scientists to be well integrated. I do not think there is ever a well-integrated reason in science to not communicate well. If JP Allain wants us to be all-hands on deck, we cannot exclude a person because they are computational.

Comment: This question is more specific to the expectation that experimentalists would be onsite. DIII-D and Princeton have all experimentalists onsite. It works best when we are coupled closely.

Comment: Not all experimental collaborators will need to be on-site all the time; they may visit or have a person on-site who represents the team.

Comment: I summarized the safety conversation with "Safety roles and responsibilities are dependent on the laws of the host and collaborators. DOE addressing this in an umbrella agreement may be useful."

Comment: Will public users be expected to sign user agreements?

Comment: State laws will apply, and institutional rules will apply.

Comment: I assume the user will have to sign some sort of agreement with the company.

Comment: A private company participating in this would sign a commitment to maintain a safe company consistent with DOE regulation.

Comment: There are group dynamics, code of conduct, and Title IX considerations that emerge in public-private collaborations.

Charge Question 8: How can public sector scientists most effectively deliver their proposed research objectives given the quickly evolving research plans of private facilities? What flexibility is necessary to ensure timely publication of research results?

Comment: We need to have in these agreements the flexibility to move from one research project to another to maximize the value of the collaboration.

Comment: From a university perspective, this is not the biggest issue since we have flexibility in how we execute things. If I receive funding from DOE to do work at a specific facility, as long as I continue to work at that facility DOE will be fine if the research slightly changes over time. From the university perspective, we have the flexibility to pivot easily.

Comment: A facility director has to balance all these interests when allocating time. Is there a plan for these project facilities to be evaluated on a 3-year basis in terms of running user facilities for university and users, similar to what Basic Energy Sciences (BES) does?

Comment: If a scientist retargets their emphasis, they should be recognized for that. That is the inherent flexibility that users and collaborators need. If we audit a facility based on their initial objectives this may not be represented, but if we evaluate the outputs that should be viewed as a win.

Comment: Things will come up, and there will have to be rapid pivots.

Comment: The use of the term "user facility" is a bit loose here.

Comment: If the private facility needs to cancel one experiment to do others for some reason, is the program manager to step in and allow if a researcher can do B instead of A. The flexibility for those types of changes is going to be needed. This happens all the time, and you need flexibility.

Comment: I agree completely. Usually there is lots of goodwill, but sometimes there is not, and it needs to be evaluated.

Comment: The quickly evolving research plans of private facilities may be tied to sudden changes in budget. There is a risk of disconnect between what the public sector research might be expecting the private facilities to be providing.

Comment: If a researcher at company A runs into problems, it seems that the researcher would need to have the flexibility to go to company B if possible.

Comment: Yes, but companies are not always aligned. That is an area where an annual solicitation could support you with additional funds to guarantee your research objectives, which at that point may not be aligned with private objectives.

Comment: Within this public sector pivots like this work fine. In the private sector, it might mean working directly for a competitor, and Company A might object to switching to Company B, even if there is a good reason. Taking knowledge to another company directly might not be something they would agree with.

Comment: To some extent, as long as scientists are doing non-proprietary work it should be okay.

Comment: Even with all the information published, the ST40 team required people with operating experience to achieve what they needed to achieve. When a company invites a scientist in, they are bringing them in for their expertise. Not everything scientists learn is in a paper.

Comment: Not having to peer review a change.

Comment: Flexibility for the collaborators to work on different topics in a quickly evolving way is critical. This should be facilitated in the funding agreement and not require a modification of the grant or field work proposal (FWP).

Comment: Perhaps the FOAs could be focused more on scientific expertise rather than absolute topical research? This ensures that if someone is funded, even if the topic shifts the expertise is still valued and the entire grant agreement or cooperative agreement would not need to be changed.

Charge Question 9: To ensure both depth and breadth of fusion research within the PFR program solicitation, a tiered system based on $nT\tau$ is being considered. Discuss options for such a tiered system. How should non-fusion efforts be weighted?

Question: Would you envision the concepts at low $nT\tau$ or high $nT\tau$ would be considered?

Comment: I think it is ambiguous.

Comment: Many companies will not have a $nT\tau$ to offer, it may be low or zero if they do not have a machine yet. I think considering this in rankings is fraught with problems, but maybe there is another parameter to rank with besides $nT\tau$.

Comment: I assume what they meant is that the highest tier would get the most funding set aside, but there would also be funding set aside for projects in the lower tier. I assume the point of separating this out is to get some breadth but also investing the most in the highest tier concepts.

Comment: I participated in a basic needs workshop on burning plasma diagnostics, and there were a lot of white papers from a magnetic mirror machine that clearly did not belong. The origin of the tiered system might be to weed out.

Comment: I do not like this tiered system, and we could need more details. If you wait until after a machine has had significant $nT\tau$, it would be too late to add the diagnostic. For a new program that is putting taxpayer money into private facilities, there should be some sort of peer vetting on the plans and credibility of the company. Some companies have more verifiable

claims than others, and I think some sort of pre-vetting (by DOE or a community panel) should be part of such a new program.

Comment: I think non-fusion efforts have to be weighted, as long as it is non-proprietarily.

Comment: There could be some facilities that do not have an $nT\tau$ at all, such as a high neutron flux facility.

Comment: I think we need to a have a venue where those things are also considered.

Comment: They should be weighted with regards to their value along with everything else.

Comment: We see a need for supporting a diversity of fusion research (different concepts, levels of development and non-fusion such as technology facilities). The choice of facilities should be related to the priorities in the Long Range Plan (LRP). We did not understand the implications of a tiered system based on $nT\tau$.

Comment: We also discussed the need for some kind of assessment of the credibility and state of companies prior to solicitation.

Comment: The review should take into account the scientific and technical capability of the facility to support the research.

Comment: There are just a few companies that are thinking of making very big prototypes or devices with private funding. If those initiatives are being undertaken by private companies, what then should be the position of the government? Should they skip to other listed priorities in the plan, should they duplicate similar facilities, or should they try to play some supporting role.

Comment: DOE makes those decisions in their own fashion.

Comment: There are the priorities of the LRP, and there is also wider basic plasma science that gets done. It is not clear how the private facilities will contribute to that. This is not to the exclusion of some other types of things that may not contribute to diffusion on the grid. I think if the priorities of the LRP is inclusive of general plasma science then the summary is good.

Charge Question 10: How can public sector researchers expedite the achievement of research-grade plasmas on private facilities?

Comment: We heard the example of ST40 this morning, which proves it can be done.

Comment: Most of the fusion expertise in the United States is in universities and national labs.

Comment: There are experimental and simulation ways to assess this.

Comment: As the example of ST40 indicated, this has occurred and the expertise in universities, national labs and industry should be harnessed to achieve this including the use and expertise of computer coeds. The solicitation should enable universities, national labs, and industry to apply.

Comment: At LLNL, we have tried to apply NNSA codes to private activities. That is something they are working on, and in some cases, it is easy and in many cases it is hard. There are public sector researchers working on NNSA. In general, bringing co-capabilities and computing capabilities and the expertise to run the codes is the main things.

Comment: They need to get good $nT\tau$, but it should not be a precondition.

Comment: We should say that they should all participate on a level playing field.

Comment: A university should not compete directly with a national lab, since they have very different missions.

Charge Question 11: What are the preferred methods of assuring mutual research interest of public and private entities? Should private company topical interest statements be included in the solicitation? At the proposal level, are Records of Discussion (RoD) sufficient?

Question: If a researcher wanted to collaborate with a company, how would they know that there is a match of mutual interest? How do we improve mutual communication?

Comment: They should put forth research topics or questions to be answered for the solicitation, the list of problems to address, or expertise sought.

Comment: If it is perceived as a weakness in their ideas, it could be a weakness for them. Should they be advertising for things where they could make a scientific impact, areas where they need help, or both? Maybe they have bandwidth to do some basic science in some area. They may not want to advertise specific interests, but they could advertise generically.

Comment: We could do something similar to how INFUSE operates with areas of priority research directions. Something that mirror the INFUSE program.

Comment: In a solicitation, a set of examples of what they are looking for would be useful, but solicitation should make clear that it is not limited to those set of topics and they should create contact points for people do discuss ideas with. A discussion ahead of time with the company before the proposal is written. That might leave the door open to new ideas.

Comment: The peer review process is another area of interest. Maye companies should be allowed to write letters of endorsement.

Comment: They sign a RoD.

Comment: This could be similar to open calls for general plasma science for DIII-D for example. From DOE's perspective, what do we need from the private company to peer review this proposal that is going to be performed at the private company? DIII-D has a contact person, but there is not a specific PI that you would need to list on the application to work there.

Comment: The proposers should make available to the facilities their expertise and interests and the facilities should make available their topical areas of interest and expertise required at the beginning of the proposal process. Identification of a point of contact at the company in addition to the RoD would be useful.

Comment: Additionally, proposals take time.

Comment: There may be a co-proposing element to their proposals, such as the university and a company proposing together. POC is at the solicitation stage, then at the proposal stage there is a lead person from the company.

Comment: When you put in a proposal, there is a line for "unfunded participants."

Comment: In the proposal a lead person from the company would be identified (perhaps unfunded private industry participant?).

Comment: The creation of a network or platform for encouraging these types of engagements would allow people to have discussions with institutions or the public. The creation of a platform to help make these connections and know what facilities are looking at going forward.

Charge Question 12: In addition to required PIER plans (https://science.osti.gov/grants/Applicant-andAwardee-Resources/PIER-Plans), are there any unique features that could be added to a PFR program solicitation to improve diversity, equity,

inclusion, and accessibility? The PIER plan by the applicant would be the main thing, but some statement from the company about their diversity and safety track records would be a good thing. Including some information on the private facility would be valuable.

Comment: General workforce development is an important element that should be included and considered.

Comment: The one thing that should be mentioned on solicitations is that they should be designed to be equally available to labs, institutions, and universities. I found some things problematic about the ST40 solicitation where DOE went directly to two national labs. I think repeating this model would be a mistake. If we could put in a statement that they need to be open to all types of institutions and that we do not need to have everything go through national labs that would be important.

Comment: The structure is one question: should this be subcontracts, should companies lead? It can be problematic to not have the universities lead.

Comment: One of the challenges with PIER plans is similar to our conversation around safety—each state had different laws. I think it would be important for central codes of conduct that overlap across institutions that should be a minimum standard. I think every proposal should have a PIER plan, and there might be things very specific to your own group and there will be flexibility there. At a minimal level, there should be some code of conduct to encourage positive professional behavior.

Comment: Obtain information about the DEI and safety programs at the facilities and how it affects the collaborators.

Comment: This information should be part of the collaboration; what the climate is like for minorities at the public and private institution.

Comment: General Workforce development, apart from DEI, is something that should be incorporated.

Comment: You could add a mentor/mentee or liaison relationship at the private companies so that the people coming in receive guidance. It is important to have someone to introduce them to other people working at that company.

Comment: If DOE can make requiring codes of conduct mandatory that can protect against bad actors.

Comment: I would like to see funded deliverables. If the PIER plan has funded deliverables, then they have to do them.

Comment: There is no funding for the PIER plan.

Comment: The newer FOAs allow the option to allocate funding for this. The unfortunate thing is that requirements imposed by DOE apply equally on every institution regardless of size, and this creates a huge burden for the smaller institutions. I caution against creating too many requirements. Diversity can be discouraged because of the extra burden that is put on the smaller institution.

Comment: This is partially why I want a Code of Conduct that is the minimum baseline, and then PIER plans can be individualized for what fits one's system. I'm happy to hear that the FOA has the new component. A lot of institutions go to the American Physical Society (APS) code of conduct as a starting point, so if FES could create a template for others to use.

Comment: Is there something that does not place the burden on the collaborating institution, where a concise understanding is part of the award that the two institutions need to sign.

Group B, Element 3 (Private run-time modalities)

Charge Question 13: What are the possible modalities for providing FES support for private facility operations for public researcher experimentation? DOE's Office of Nuclear Energy engages in a reimbursement model with private companies through their NSUF program. Could similar models be applicable to this PFR program? What other programs could serve as a model?

Comment: This question specifically mentions FES but there should be more partnership opportunities This is a big challenge because there is a need to overcome cultural divides.

Comment: Funds and reimbursements should flow more easily not just FES but NNSA. Private sector reimbursing is harder where it may be faster with DOE researchers, but maybe not in all cases.

Comment: Cost recovery difficult and requires detailed accounting. Need to distinguish between facility time with operational staff and capabilities available like hardware for machines. Capabilities that are owned by DOE and used on DOE time.

Comment: Setting up a facility as a user facility can be a major undertaking. Starts as public access used later by private companies.

Comment: Using the SPARC model, there could be an exchange or trade where DOE supplies big hardware such as a neutron beam to a facility and after a company has met its milestones it can later become a general public science user facility. Diagnostics would be a collaborative effort since cost is not as measurable. Not just in plasma but in other areas related to fusion.

Comment: We can help test infrastructure and being outside of the national labs this can help with agility and speed of construction.

Comment: Our model is managing collaborations, whether we own the facility or someone else does. We manage user groups. Most of these models already exist.

Comment: Must also consider guidance questions like a university uses for its research guidance. This comes through conflict of interests which we do not typically think about in fusion.

Comment: In modality and oversight, universities emphasize transparency. Not necessarily so in private companies. Will these be publishable for a company? Used big pharma as an example but could happen with fusion. Publishing that can damage a company's bottom line.

Comment: Example in big pharma: if there is some drug that is going to kill a lot of people, there is a conflict between free publication of the scientific results versus the amount of money at stake on the private side. As fusion becomes more a reality, this is going to occur in this industry. What if there was a fatal flaw in a high temperature super-conductor. Business risk or public safety risk questions will eventually happen in fusion industry. This is a big discussion. I haven't seen it anywhere.

Comment: Pre-arranged cost share models between the government and private companies in exchange for experimental time. Private companies need capital and exchange facility use for DOE funds.

Charge Question 14: Understanding the uniqueness of each facility, are there any general principles that should be applied to determining experimental 'ownership' of a research project?

Comment: Going to be set in the agreement or contract together before running the project.

Comment: Project may not be well-defined but in general many facilities believe that the experiment is owned by program or institution.

Comment: Program institution is responsible for the dissemination of the data and results.

Comment: Private company is running program or experimental time then it is their data. If FES is running the experimental time, then it is their data.

Comment: FES may only be part of the project. Who owns the research project?

Comment: Must have an understanding what ownership is. Needs to be defined and pre-negotiated.

Comment: Owning the research project is owning the data is part of the definition. Contracts can determine who owns the data.

Comment: Ownership may not be the correct term because ownership can be broken up into many parts. Someone can own the data, someone else can own the procedures, etc.

Comment: Some type of ownership may also belong to the participant who owns the most risk, accountability or responsibility maybe not necessarily the data, but they should be given something back for taking on the risk.

Comment: May already be addressed in the contract so you do not want to re-invent the wheel.

Comment: After a 1.5-year period will you publish material, or will the data be proprietary? With public funding private companies must be willing to publish.

Comment: Data needs to be seen when results are made known.

Comment: Something proprietary may require some level of review.

Comment: Knowing where the IP is and seeing if it's worth collaborating on or sharing.

Comment: There should be a clear vision of the IP but at the same time, companies need to keep their private sauce.

Comment: NDAs may also be considered.

Comment: Open source on an 18-month time scale gives the company enough time to do IP and get a patent and then publish.

Prior art also needs to be considered.

Comment: Example from physics, involve divulging much proprietary information for a model encourages venture capital and investors.

Comment: Analogy from pharma, publishing after 25 years after drug discovery. For fusion we can decrease this to 5 years.

Comment: Private prefers owning publishing rights but value from DOE may force some loss of control by private companies.

Comment: Is the public better served by a period of open science after the original mission or is the public better served by securing data rights? I contend that a program that emphasized public data rights for as much as could be gathered on the original company-mission would serve the public better. Company driven-research program is more useful to the mission.

Comment: In meeting milestones, more aggressive data publication plan by DOE risks refusal by private company. Less aggressive plan may lead to more cooperation

Comment: Piggyback on diagnostics. Private company may see benefit. Piggy backing will also require contractual agreements. But diagnostic may have lower risk. Or mitigating risk. If risk is too low, it may stop the plasma shot.

Charge Question 15: What fraction of operational private facility time could be available for public researchers? How might this availability evolve as company milestones are reached? To what extent can 'piggyback' experiments be used?

Comment: Milestones in private companies have shorter phases than a typical DOE public facility.

Comment: Decommission old equipment to universities. Our company developed dipoles in sequence and is the only device in U.S.. This ended 14 years ago after we reached our milestones, and a university may want equipment as a hand-me-down.

Comment: At Pacific, machine operations are dedicated to milestones but once done with that milestone we can transition to a user facility to keep them going.

Comment: Is there an incentive on the private side to achieve milestones? What are the diagnostics and is it funded through DOE.

Comment: Actually, the company has outside people to verify that we achieved the goals that we set, otherwise it's just internal to the company. Most outside people are financially-minded investors, but they hire people who can ask those detailed questions.

Comment: What about the government side? Does government employ regulations to verify and audit when generating new source of electricity for example.

Comment: Private sector sees value to have DOE verify result. More likely for funding with verification. Confidence that public sector will deliver in a timely fashion. DOE order of magnitude. So many funds for a facility, may be a one-time shot. This can be a strategy to obtain a machine. Minimum program amount for company. Small amount of money may not be worthwhile. Can apply to non-fusion companies.

Comment: What is DOE's plan if a company fails? Is there a bailout? Answer is above DOE. Unless it belongs to DOE. Even a database can be important and should be retained even if the company fails.

Comment: In a private company, cannot go forward without reaching a milestone. If public funded, it will either be for reaching the milestone quickly or right after the milestone is reached.

Comment: Model also cost share with negotiated exchange that may be unrelated to milestone, but still a necessary expense. This may include extending the runway to reach the milestone.

Comment: Like a 50-50 Accepting public funding and having public use the facility for research in the future.

Comment: Licensing agreements help increase the money made by the company.

Comment: Companies could get future workforce from students at public institutions working at their facilities or on their devices.

Charge Question 16: What is the preferred mechanism for providing FES support for accessing private non-fusion facilities or capabilities to carry out plasma science research for non-fusion applications (e.g., semiconductor nanofabrication)?

Comment: There is precedence for a DOE contract with a for profit that may be fusion-related. Making targets as a supplier for risky fusion companies.

Comment: Venture capital or DOE funding in commercializing laser cutting and other non-fusion related companies but can make fusion companies self-sufficient.

Comment: Magnet companies could be used as well.

Comment: FES can help with finding other government agencies such as the Department of Defense (DOD) for similar contracts.

Charge Question 17 (developed by the group): How can PFR help the work force?

Comment: Example of a summer internship program in New Zealand mostly undergraduates in Engineering.

Comment: Can meet DEI workforce goals.

Comment: Confluence of existing workforce and how PFR can be involved.

Comment: Experiment started can be continued.

Comment: Internships are common, but there could be more levels, more at the PhD level as opposed to master's level.

Question: Mentoring program—Who is doing the mentoring, the institution or the company?

Comment: Taking two programs, such as an internship with masters. Take a major outside of fusion and maybe get a fusion certificate.

Comment: This could be considered a modality as discussed in Charge Question 13.

Comment: International collaborations with students should also be considered by DOE.

Subcommittee Breakout #3

Group B, Element 1 (Data Repositories)

Charge Question 1: Discuss the partitioning of proprietary and non-proprietary data and the sharing of nonproprietary data with publicly sponsored PFR program collaborators.

Comment: I'll start with a different perspective from the Supply Chain it depends on scientific tools. I work with software for machine learning (ML), so my tool is data. Without data I cannot build ML tools to benefit the industry, this leads to improve ML. It's like game theory. You can collaborate so everyone wins.

Comment: Do not understand problem it is trying to solve. Converse is not true with public data.

Comment: Parallel conversation sharing data depends on what value you get back. Maybe there could be tier-leveled access with some sort of cost entry. Nuclear fuel providers are notorious for keeping data, but they will also share under a controlled environment. An agreement to share. One-way streets give but do not get anything.

Charge Question 2: The regular (e.g., daily) mirroring of non-proprietary private facility data to a centralized public repository both protects public collaborative research investments and preserves essential data for both public and private benefit, but it is not intended to be the primary data access point. What criteria could warrant public researcher use of data stored in a repository (e.g., in case of company bankruptcy)?

Comment: If I am collaborating with publicly funded people, then they will have access to my own systems where the data lives. I do not see any advantage to mirroring on a system that I do not control.

Comment: ST40 for example is not proprietary, it is open resource. I do not think mirroring is necessary.

Question: Think about the criteria would the public researcher need to use data. Are there conditions where this becomes acceptable, or would it never be acceptable?

Comment: It depends on the data, even in a bankruptcy. It also depends on what the problem is. Is it like disaster recovery or normal recovery events? This may be a more useful framework than mirroring.

Comment: There are data escrow services, a lockbox data of sorts with "break glass in case".

Comment: That's an important point because mirroring implies that you take data from some certain repository and then you broadcast it, or it is able to be broadcast.

Comment: This may be dead in the water if an institution says that we do not want that. Even public institutions do not want that loss of control. Maybe they find out that 5% of its data is corrupt.

Comment: At Columbia, the legal department is kept busy and spend long amounts of time negotiating NDAs

Comment: Standardization of databases and public repositories would be great and would lead to better data agreements and more expediency.

Charge Question 3: Are there alternatives to data repositories that achieve the same protections?

Comment: You need to find out what is meant by protection. I'm confused. Is this discussion around backups? You can store a terabyte of data on AWS for a dollar amount.

Comment: Private companies do not put their data out there because of IP, but you may want to support a common development for a common need; something that people can agree on. But to blindly do it for no reason has no value.

Comment: Data repositories for universities and lab- No need for strong protections.

Comment: I can see the purpose of making a data repository for labs or universities. The alternative is you give an individual from the labs or universities access to your data repository and all your data. But you can have permission structures where the company can also have a separate system so labs and universities are not accessing the full system. Again, not a one-way street. Must be reciprocal.

Comment: How about developing own code validation. Every company develops their own code. Can there be collaboration on code. Some institutions have been working cooperatively on this. Certain types of codes are not collaborative. Others are.

Comment: Accessing data with NDAs. If there is a need for a supercomputer, you are not allowed to mount data on data disks I'm not allowed to ship data do calculations. But I can use the database on site.

Charge Question 4: The establishment and maintenance of data repositories is non-trivial. Discuss anticipated public and private levels of effort. Should private company costs for establishing public data repositories be supported by FES?

Comment: Assumption of maintenance only by DOE or are there other entities. Reluctance in the private sector. Data can disappear once funding runs out.

Comment: Data linked to repositories, but perpetuity is questionable.

Comment: There is a list of technologies that were probably going to build these anyway. We could allow DOE interactions in a cost-sharing way.

Charge Question 5: Is there private company interest in mirroring their data to a public repository even in the absence of an initial public collaborative research effort?

Comment: No, not solving fusion problems for money, it is a global climate issue. Need to share data for this purpose.

Comment: Qualified yes. There will be many dipole companies after milestones are reached. But the first company has a competitive advantage of being first.

Comment: Private companies can benefit by public contributing to code and improving it.

Comment: Catalyst of public contribution to data used by private.

Comment: Can have a consortium which is not fully public, but open to both public and private. Because private contribution to consortia.

Comment: Enough money for data repositories. Idea of data containers are attractive.

Comment: Can public data go into these repositories. People tried to collect the data together and put it in the same format to do data science. It's a lot of work. There is not a core centralized way to do this. It's being funded right now. Fair policy of databases may be a solution and is being investigated. Security issues are also a concern; may not be able to share everything but that may be a topic to consider. There will be export control issues.

Comment: From DOE, is this program only for U.S. researchers for U.S. companies. Supports U.S. fusion researchers.

Comment: Role of foreign companies should also play a part as well as non-U.S. researchers.

Comment: There are many facilities outside U.S. that can benefit U.S. Fusion facility.

Comment: FES benchmarked non-U.S. facilities to reach a goal.

Comment: Internationally, U.S. and U.K. signed an agreement and working on one with Germany.

Comment: The Organisation for Economic Co-operation and Development **(**OECD) also has existing frameworks in this also.

Comment: A consortium that would be beneficial discussed earlier.

Comment: There is one being formed at MIT, establishing the framework.

Comment: Ex. With SemiTek, buy into the consortium, set up questions, find answers, and share IP and went for 20 years.

Comment: It was a model of U.S. leadership.

Comment: But with companies that were already profitable. Require significant resource input into private companies.

Comment: Goal of consortium to maintain U.S. leadership and competitiveness and contribute to the overall ecosystem.

Comment: Connect this with a supply chain for materials for these companies (part of the ecosystem)

Comment: Much overlap with the drivers of these consortium

Comment: Either have a big collaborative or smaller one, depending on the size of the problem

Comment: May not be agreement among all the collaboratives which can be challenging.

Comment: This maybe something that FES may want to develop.

Comment: Equity also should be considered, based on monetary contribution.

Comment: The SemiTek consortium was both public and private

Comment: There is a similar consortium model being implemented in United Kingdom, prevents one large company from taking up the all the resources.

Comment: DOE money leveraged to Nuclear Advanced Manufacturing Research Center following this consortium model.

Comment: SemiTek was 50% cost share and members contributed 1% of sales.

Comment: Electric Power Research Institute (EPRI) is another example, which is non-profit and funded by utility. Tech transfer, hire suppliers to do the work.

Comment: This gives FEC a chance to propose some type of collaborative model.

Comment: FES has done a supply chain evaluation for readiness.

Comment: Need to Coordinate companies for this.

Comment: Example of laser diodes talking to companies to convince them of switching from high proprietary to more standardization. Challenging undertaking.

Group C, Element 2 (Solicitation)

Charge Question 6: A fundamental tenet of the PFR program is the freedom of public sector researchers to publish experimental results from private facilities. Identify sensitivities and paths for resolving them (e.g., 1 mo. publication embargo for private company courtesy review).

Comment: University of California policies require that research must be able to be published in a timely fashion and will not be reviewed by non-academics.

Comment: DIII-D policy is that it must represent DIII-D data, maintain scientific rigor, etc.

Comment: IP reviews do not contract publication rules.

Comment: ITER has consistent messaging it would like to see, as scientific conclusions have been debated.

Comment: Some publications raise concerns about the safety and success of implementation.

Comment: Commitment to open science varies across private facilities.

Comment: If there is disagreement about what constitutes IP or not regarding scientific results, what is the solution? Generally, it would go back to the initial DOE contract, and failing that it would go to court.

Comment: Publications should remain in the scope of the initial agreement and the contract, and discussion should be had for discoveries outside of scope to avoid stepping on the toes of those who are in the scope of the new discovery.

Comment: Private companies may take issue with discoveries out of scope leading to other out-of-scope work and publications.

Comment: If DOE wanted free access, they should have built the equipment.

Comment: Discoveries made in private facilities are their IP, your sitting in the chair does not make it your IP. This is where negotiation and deals with private facilities can be discouraging for academia and government.

Comment: It is discouraging particularly for tokamak research because it is impossible to isolate one physics topic in tokamak.

Comment: Specific focus and scope are part of the contractual process.

Question: As a public researcher, if one cannot publish one set of data and discovery, would they be able to take their knowledge to another facility and repeat it for the purposes of publication?

Comment: NDAs are another important topic – as well as the responsibility of the facility to not share what they do not want outside users to see. Private facilities acknowledge there is a certain amount of risk and their responsibility to limit information access. The type of

agreements may rely on the type of data generated. Established levels of trust also ease the contract process. There needs to be some sort of global guidance about how to handle information unintentionally shared with non-facility personnel. INFUSE very specifically does not include anything about IP – it is not a large enough program to address complex legal issues. Why not make IPMP good for the same length as CRADA?

Comment: What duration would be appropriate for FOAs? Phases should be considered – active phase with physical involvement with machines, and non-active when processing data and publishing results. Nonactive does still need cost coverage; while it is less costly than using the machines, there are expenditures. It is under DOE discretion, but 3-5 years allows for PhD student inclusion, whereas 1-year grants do not. 1-year grants are difficult to make headway with because staffing is not flexible enough to accommodate. CRADAs are 3-year frameworks, but the expectation is to seek funding annually. IPMPs function differently. 3- to 4-year projects that have annual phases may be a solution. It gives a long project, but also flexibility for start-up.

Charge Question 7: Public sector experimental collaborators are expected to have an appreciable on-site presence at the private facilities (e.g., those contributing diagnostics and other hardware). Discuss preferred paths for site access, safety, and data access?

Comment: That is an assertion—do we agree with the assertion? Do the private company representatives want a bunch of university folks wandering about your place? This does contradict something we said earlier which is if the public sector users are acting more like the Frontier Science people at DIII-D or they are just science consumers and that there is a core team providing the facility that is the host. Then the users might be just turning up for two weeks at a time, and it may not be very hands-on.

Comment: It depends on whether you are in the embedded model. We have a CFS affiliate program, which manages data access as well as physical site access.

Comment: We have practiced for the few times MIT is the first location. We are better for where researchers have a badge that can access and get into our buildings and work on site with our magnetic team. We expect to have MIT scientists, grad students and PhD students. They will need to go through safety and accessibility, but we are intending the Devens site to have visitors in that sense, but I think you indicated that your collaborative model is more that the users are going to be consumers rather than embedded providers.

Comment: This this is independent of who sponsors it, right? We have CFS-sponsored researchers, and we need to set that up. Regardless, I think we'd expect to extend that model in terms of site access and safety.

Comment: There must be a discussion about access versus rights, but safety is definitely the one that is a priority.

Comment: There are usually framework agreements that we sign with institutions and then task agreements below that that are specific activities, but the umbrella agreement has in the data and non-disclosure and kind of bigger picture things.

Comment: Yes, a framework agreement and then specific scope of work under the framework agreements and everything to help us manage confidentiality and how to handle preparatory information, such as addressing needs for trainings for people on site. And again, abiding by, health and safety rules so that everyone onsite can operate safely. I think you are going to see with every company that if you want to be embedded and working with a team closely then you are going to have to sign some sort of third-party agreement.

Comment: When I was prepping for this meeting, I started off twice by thinking all the things we worry about for users and there is a whole series of topics that is not covered in these questions. Providing equitable access for user boards and DEI support and workforce development. Open access to roles.

Comment: Equitable access to data is interesting because we will be able to pick people that we want to do things and they will retain the right to say things such as "no this institution gets it, not that institute."

Question: Is the DOE setting aside money for public sector users, or are they using the private sector to pick the winners? Because we have the right to pick favorites because that is different than DIII-D and because we are trying to achieve a mission goal. That should not be seen as not supporting diversity—that is us prioritizing our mission.

Comment: We are not obligated to work with everybody. The application process is not double-blind, and we would not want that. We want to know who was proposing with specific experiments like because we have mission goals to achieve in a certain amount of time.

Comment: The FOA process is not anonymous—just our experiment selection process. That avoids automatically selecting one's favorite scientist and focuses on the quality of ideas.

Charge Question 8: How can public sector scientists most effectively deliver their proposed research objectives given the quickly evolving research plans of private facilities? What flexibility is necessary to ensure timely publication of research results?

Comment: Topic flexibility, facility (public or private) may not be capable of delivering the original planned conditions. Evolving to what is possible.

Comment: Diagnostic availability may be a challenge.

Comment: A publication is a snapshot in time, being aware and up to date on the current science will enable further progress. Collaboration between public and private facilities so new capabilities are known will aid in keeping research relevant.

Comment: Keeping up with capabilities and matching proposals to those capabilities will ensure success – but that knowledge may depend on existing relationships.

Comment: It is established at the agreement stage that if two entities are developing a machine or diagnostic, who will own the IP of that work.

Comment: IP agreement has to be flexible enough that collaboration is possible but entire fields of research are not locked off.

Comment: If DOE sponsors development of a device, the hardware belongs to the company, but what will happen with the data? Does it need to be segmented to protect proprietary information? Access versus publication privileges comes into this discussion as well. These principles all apply to diagnostics as well.

Charge Question 9: To ensure both depth and breadth of fusion research within the PFR program solicitation, a tiered system based on $nT\tau$ is being considered. Discuss options for such a tiered system. How should non-fusion efforts be weighted?

Comment: Displacement per atom (DPA) is a good metric for radiation exposure

Question: We discussed already the engagement tier, and this is more about like facility tier. Their proposal here is this $nT\tau$ facility tier. Are there other options for a facility tier?

Comment: You might have supporting technology that developed by other facilities or other devices that may be important for a great technology like a tokamak. Once a device gets

through a high enough nTτ, you may no longer want a lot of research dollars into that. You may want to put into other facilities that support the technology.

Comment: I would personally advocate for the size of the staff as a good metric because that tells the scale of engagement you are dealing with. A really new startup with under a hundred people would be a different beast than a thousand-person company.

Comment: The nTτ goals will be different for different sorts of devices if you get well beyond that. Goals will be different for different sorts of devices if you get well beyond even beyond magnetic confinement.

Comment: I'm not sure if having tiered systems in general is incompatible with the idea of growing, because by default this means that we are identifying specific companies and ranking them in some way.

Comment: Do we want equal amounts of support going to LLNL as CFS? You have to get past a certain point where there is some number of reliable results that it is worth the public investment, but I do think it's not monotonic. Once you are at certain TRL it should be an applied energy program to grow it.

Comment: But the tone of the question seems to be to try to expand to some of the concepts that might get less attention normally because they have lower traditional performance metrics.

Question: Is there something in terms of timelines and capabilities as well? And how this will evolve over time? Others have a little bit more runway.

Charge Question 10: How can public sector researchers expedite the achievement of research-grade plasmas on private facilities?

Comment: Operational familiarity, depth of expertise private organizations can tap into.

Comment: What about other concepts private facilities aren't as equipped in? Diagnostics, software tools that have been developed for plasma experimentation could apply to TK. High-performance computing falls under this umbrella.

Comment: Good data management will facilitate research-grade plasmas; the public sector can contribute to that.

Comment: We can partner with existing public institutions if we are willing to write agreements and there is nothing that is stopping us from partnering people or even hiring people who have that expertise. But there is a barrier to quick interaction and quick help because it's seemingly different than say if this was an international collaboration because it's helping a private company.

Comment: When trying to figure out some technical issues with the Resonant Magnetic Perturbations (RMPs), I was trying help and they went out and had to ask a few people to do some analysis for us. And we ended up with Oliver's group in Wisconsin because he wasn't encumbered by DOE or Wisconsin funding. He could do research with a private company without approval or provide us some calculations of having to kind of go and approve it at some point.

Comment: There is a check valve here. It is how can the public sector help the private sector? I think we should acknowledge the private sector and all the public sector facilities; some of the physics operations are now employed by CFS. I think understanding how we could get some of that expertise back to help with the public sector.

Comment: There is officially already a path though, right? When the National Spherical Torus Experiment (NSTX) FOA comes out, a company can apply and bid for resource and just the same way university can.

Question: What is the benefit to the company—do they get any scientific value in participation?

Comment: The national labs boast these highest performing computational resources in the world, but there really is not a way to access it. And that is true across the DOE companies: the high-performance computing really is very tightly held. And I think it's worth this beyond what FES could do by itself.

Comment: And the user facility thing, the nuclear one that we saw this morning, one of the things they did was provide high performance computing to the private. It is not just computing, it's actually code development.

Question: Is there a concern on the private side that the public research comes and achieves some things on your facility? It becomes part of your secret sauce, part of your primary deliverable or something This was done with public sector money, so now the government will say this is publicly owned and must be shared.

Comment: This is what I think what is meant by the milestone agreements. It is a lot of risk for not very much money.

Charge Question 11: What are the preferred methods of assuring mutual research interest of public and private entities? Should private company topical interest statements be included in the solicitation? At the proposal level, are Records of Discussion (RoD) sufficient?

Comment: As a public researcher, I would like to see topical interest statements because it indicates what people care about.

Question: Do you know what our priorities are and how would you find that out? If we say we are going to be mission driven, then you are going to have to do research to blend with our milestones.

Question: How do you know? Do we need to put out a pre-statement? Does this mean we need to give Josh something in the FOA that says, "Here's what we are looking for"?

Comment: It's even more important for the private because their mission need is very targeted. It's going to be timely and connected with having statements in the FOA allows you to pre-filter much more effectively. And so, people can tailor their preproposals. FES has grounds to reject if they do not align with the company's mission.

Comment: They probably prefer to have it. And then you need to preselect all companies that would be aligned. And would you want to be in negotiations with that? We are interested in supporting that. Could you do a teaming list that may be a workshop?

Comment: Strategic planning exercise is good. I think you also need this because of the way FES operates necessitates a separate private discussion.

Comment: This also makes it necessary to pick which companies are in the game. Workshops are a very good idea because it not only establishes the topical scope, but it actually can generate some interest as to what is possible through some brainstorming before the specific opportunities are there.

Comment: I think it's not good as a pre-filter but at the proposal level.

Question: What else should be asked? We have got the topical interest statement, RoD. Are those two things together enough? Should there be anything additional?

Comment: Yes, is there any reason why they could not include private companies as reviewers or that they should? They have a bunch of individuals that they use. So that conflict of interest (COI) concerns there would be profound.

Question: Is there a COI in CFS giving prioritization?

Comment: They shouldn't be reviewing things that are. They would have written in the RoD little secret language that made it very clear to DOE who they want to prioritize.

Question: How do we assure mutual interest? This is all about nonproprietary research, right?

Comment: Whatever the fruits of the research are, it will be made available in the public domain.

Comment: Should we identify any other formal steps as part of the proposal process? I've identified some informal things.

Comment: I do not know if this fits, but we now have a user board on DIII-D and this which is executing some sort of oversight.

Charge Question 12: In addition to required PIER plans (https://science.osti.gov/grants/Applicant-andAwardee-Resources/PIER-Plans), are there any unique features that could be added to a PFR program solicitation to improve diversity, equity, inclusion, and accessibility?

Comment: Are there any unique features that could be added to the PFR to improve DEIA? Did you mention the data fairness?

Comment: We understand diversity broadly and this may be a little box. But this has been very focused on research, including technology aspects.

Comment: The imbalance we get in nominations for all sorts of things. Part of the answer there is to solicit.

Comment: So, I think that maybe goes a little bit beyond PIER plans to being more proactive.

Comment: Encouraging proposals from more diverse parts of the community. That would mean not all the nominations for awards are white males, for example.

Comment: Private companies have demonstrated a commitment to these things that are important to do. They are going to be through slightly different mechanisms just like different labs or universities.

Comment: The companies have to show that commitment and it's in our best interest as well of our workforce development.

Group A, Element 3 (Private run-time modalities)

Question: Is this a model that people see as a possible option? Are there any other models?

Comment: MST-1 in Europe is an example. EUROfusion effectively purchased sections of run time on existing European Tokamaks. Draw some inspiration from that program.

Comment: Broadening the machines of the private facility is interesting.

Comment: Differences in how the problem and the program is structured, particularly for billing teams across institutions and bringing in collaborators, has been a super successful model.

Comment: There is a set of organizations that do this already. Large ground-based telescopes are all privately owned and built by foundations. Public researchers get access to them, and the NSF will buy, build, and install a spectrometer on that telescope. The foundation gets less interested in running the telescope and give more time to the public in response for paying the marginal operating cost of the telescope, i.e., Keck in Hawaii and oceanography ships built by large billionaires.

Comment: LaserNetUS is another example. They have a call for the facilities where facilities compete to be part of the program. Then users can apply in a separate call to get access to those facilities and FES reverses the facilities at the cost at the run time. FES is expanding that to include a specific class for diagnostics and other things as well. This makes that quite a flexible program.

Comment: Public taking over a large share of the run time could be beneficial for both parties because they have large capital investment, and the private company could purchase time or purchase the facility. It would be a benefit the private company where they can recoup some of their cost, and so the public gets the device that they probably would not have been able to build.

Comment: National Laser Users' Facility (NLUF) program is another example as well as NASA Omega. This is really science experiments more than installing a diagnostic.

Comment: This is getting at this evolution where private companies have a very critical path, a time-sensitive element, as they start marching through and achieving their objectives.

Comment: We can see opening for broader engagement.

Question: There are lots of small companies, new companies, coming up, other than Westinghouse. There was no private company in that program. What is the reason for that?

Comment: It basically duplicates what we are considering here, which is a private company.

Question: Is that model working for private industry?

Comment: The element of Westinghouse was that they had excess time at their hot cell. Basically, the public became a customer for it, so they are using that facility 90% for their own purposes, and 10% or so on the other side. The national model with all the contract elements in place within the department could be potentially adopted and have a broader mutual benefit to the facility.

Comment: That only benefits Westinghouse.

Comment: They are not going to want to run it all the time and they are going to want someone who can keep it running and make it useful. The companies are still growing and will come up with things to do that they didn't think of, i.e., MIT magnet test stand. We have other test stands, and we still go back to that one. How do you make these facilities stay around for a long time and have a flexible model and be responsive to the needs of people around them as they grow up.

Comment: Frontiers of Science program. Multiple user facilities under a single proposal. Private and public users all under the same program. Submitting to a consortium of possible facilities and selecting one within the process, not individual process between each facility.

Comment: Important to document because we do have the difficulty of the unique facilities themselves and their research interests.

Comment: Operational facilities. You can identify operating a facility as a business model and in a push to fusion. We do not want to create an ecosystem in a private industry that sees their business opportunity in operating the facilities to build in high capital investment.

Investors will not be happy. Lots of questions of IP and basically everything their doing is considered their IP when they are working on this new reactor systems. I think this will be pivotal and private industry will select their collaborators. It is not in their interest to share any information.

Comment: Vision really works. It is a question of how much open research is available.

Question: It is okay to choose a particular facility if it is unique enough? For example, a space station?

Comment: There's an overall theme that there is an evolution of the needs and demands on the facility from both the public and the private side. Think back to the solicitation stage about how in the early phase there a capabilities team might be to get things going and the facility evolved and that operations teams could transition to becoming more operations support during the later phase when private companies meet their milestones. Continuous model with a capability team that supports operation could be an effective way to do that.

Comment: A lot of these discussions point towards the need of the private company, and there is an interest in the public experiment in the public.

Comment: That is baked into the Office of Science.

Comment: We use publicly built facilities and pay for runtime.

Comment: We are missing the Joint Research Target (JRT). We are piecemealing all this together. Pick any of the gaps. If you want to close them with a team that was international, use the best facilities, private and public, and have public and private people in it. That would be a powerhouse.

Comment: If we have this kind of agreement, then the kind of integration you are talking about is a possibility.

Comment: Under an Other Transaction Agreement (OTA), DOE has unlimited authority. Certainty in funding and financing would be very helpful in some of these efforts. This program is authorized and here is an award. Would there ever be any money for it? We are not building a science research facility; we are building a very specific integrated system prototype. It's a minimum viable prototype. In the site selection effort would be afterlife. Is there anyone in the area that would be interested in taking over and running this facility once we hit our milestones. We do not want to be in the business of running a research facility. To have a capability entity that is with us as we design it. There is opportunity to work with us at this point. Leave room for that on the backside. Provide more utility for science and research once we are finished with it. If there are things we can avoid as a cost because DOE owns it. Perhaps a consortium model of operations. Upfront financing would be a win for DOE.

Comment: The capability goes back to teaming. It is not just the researcher. It is engineers and technicians as well. I hope we are starting to get in this mode where we are working as units, not as silos.

Comment: This program is for the private companies to use this mechanism to do research at other private facilities. There are examples of private industry getting DOE grants to do research in the non-proprietary space. I could imagine private companies may have places where they want to do non-proprietary research.

Comment: There's a business model up there that that is their whole deal.

Question: What would happen if a private company applied to this program to work under another private company?

Question: Could this be used by a private company to get DOE funding to do public research?

Comment: Not a question we really considered. There is a dividing line there.

Comment: General Atomics is a private company so there is precedent for that already.

Comment: Consortium of the facilities or individual, such models as NLUF, based on shared information between user facilities. How would this program focus on improvement and how it would make sure that users are satisfied at this user facilities? Do you have a new committee which represents both private and public entities and users, or safety issues?

Question: Could there be a way for the labor or the university to have a way to get this commercial arrangement without getting into the commercial side?

Comment: So long as there is a public researcher that are tied in with that development and there is openness on the company's part to relay that data or make that data proprietary and available, it is a fit.

Question: It is unlikely private company will change business model based on this thing unless it gains something. The question is what is accessible? Anything on the fringe may be open. How do we put that under one umbrella for everybody and every company?

Comment: We are not in business to develop user facilities. These discussions have been going on behind closed doors and at all levels of leadership.

Comment: It takes money to run a facility and takes cost like this program will support. I'm not sure how many companies will be allowed to do it unless there is a support to that kind of stuff.

Comment: There is value here and throwing off data and having people that are curious look at it for all sorts of reasons. Tesla is an example. Ecosystem argument is real. Amplification is the point.

Comment: One big point in shaping this program is going to be how to re-evaluate based on performance, not of individual grants. Is the program working for the public and for the private? How do we establish another kind of a user board or private representation within this program? And then, how to re-evaluate what worked well and what didn't work well, lessons learned and readjust? Obviously, community input will be sought; a manageable number of opinions that are diverse.

Comment: Part of the idea of the program is that it is opt-in. It is self-monitoring. Folding it into the Fusion Energy Sciences Advisory Committee (FESAC) charge to evaluate the effectiveness is something to consider.

Comment: Difference of success in public vs private goals. Notion of what is success is difficult. INFUSE is an example.

Comment: The way we measure ourselves already is by impact. I think we are still firmly in that space on the public side. How do we capture important impacts is a great question.

Question: Any non-fusion participants in the room?

Comment: Personal impression. When do you have a developed ecosystem around it? That is really the fundamental questions that the companies do not see. Like creating revenue in the next 5-10 years. Environmental impact? Gas supply chain? Industry has success at a high processing rate of their equipment and needs to find places to give it to. Universities are getting a lot of benefit by using leftover pieces to innovate on the science. Industry develops new types of sources and also have specific measurements that are high fidelity. University comes in as a partner to take these measurements and provide a setup. This industry will mostly be interested in having these basic fundamental sciences calls out there.

Comment: Foundational information that they can use.

Comment: Mutually beneficial connections are possible even in semiconductor industry which is very competitive. Things are possible to go beyond what is possible.

Comment: Good opportunity for semiconductor industry. The university is the bridge.

Comment: In kind hardware sharing. Public sector giving in kind hardware to company or vice versa. Both should be discussed.

Comment: Modality was the consideration that the ultimate thing we would be after in the public sector would be a dedicated experimental run time for public researchers on a facility.

Comment: Flexibility in the program that if the company has supported public research, the public or public family should be able to support if the company required that instrument.

Comment: If the company provides public run time, there might be an avenue to sort of request or in some way solicit support for an advancement on that facility or enhancement.

Comment: Not to pull away the program so soon as the research is gone but be sort of a contribution. That should be built into the program.

Comment: How do we engage public/private entities together? Look at the Small Business Innovation Research (SBIR) program. Obviously not the same thing but it has overlap. Redistricted to small companies. I assume this would not be for large companies, however, universities and labs can work on those things. Another model within the government that is across all the agencies. We should think about what we can learn from that and apply in this space.

Question: Is any hardware purchased under an SBIR project in the Office of Nuclear Energy?

Comment: It depreciates as an asset. SBIR good example of where a company may develop a capability and then eventually use it for research. Pegasus III is an example.

Comment: Practically what we can do will be determined by the number of resources.

Comment: ST40 engagements are consistent with that. More in the diagnostic space for the future. Rolling out a future program. We are entirely dependent on annual budgets and congressional appropriations. JP is very enthusiastic about this program and making it a priority in near term.

Comment: If it's a small amount, we are not interested as an entity. A larger program is more advantageous for us.

Comment: There is a threshold to investment.

Comment: Could you have formed a long-term team, etc.? Probably not with a small budget.

Comment: With Tokamak Energy, we knew there some sort of threshold investment here to ensure that there was scientific productivity that came out. Threshold for which below is marginal in value.

Comment: Move to a pilot program. Smaller scale and see the interest and see it bootstrap is a possibility.

Virtual Attendees, Element 3 (Private run-time modalities)

Charge Question 13: What are the possible modalities for providing FES support for private facility operations for public researcher experimentation? DOE's Office of Nuclear Energy engages in a reimbursement model with private companies through their NSUF program. Could similar models be applicable to this PFR program? What other programs could serve as a model?

Comment: Is this similar to how the European Union buys runtime for facilities to use to allow for meeting the mission of EUROfusion? If there is something critical to the mission of

FES or Fusion, and they are able to access regimes for code validation or other aspects, then there should be a mechanism for us to pay for run time at their facility. If it is critical for the U.S. fusion program, I think we should be able to buy runtime. Naturally a facility can say no, but I would hope that that mechanism would exist.

Comment: It may be where a public facility has met their mission, and they want might to allow for people to purchase run-time for all sorts of projects. There should be a mechanism for that.

Comment: If critical for the mission of FES, FES should be able to buy run-time.

Comment: The other modality is to write the need for run-time directly in the proposal and write a subcontract for it.

Comment: The proposals for conducting research could identify payment to the company for run-time. This is the reverse to the way National User Facilities do work of companies.

Comment: Within proposals right now, there is a line for paying for services elsewhere which does not need to be a subcontract; so, if they are not participating directly in the research, it does not need to be a subcontract.

Comment: I'm all in favor of allowing buying run-time, but I'm nervous of making this the norm of collaborations because this can get very expensive. Another more preferable modality is that the company would endorse the idea and the company would provide the run-time. Where this can be done this would be the default.

Comment: A preferred modality is that the work is beneficial to the company and the collaborator, and the company would provide run time.

Comment: Yes—because it can run out of control easily.

Question: Buying the runtime is cheaper than building a facility, correct?

Comment: It depends. This provides the flexibility to explore this space.

Comment: I would hope that this scheme works. I think it would be valuable for FES to explore options; all of these options should be explored based where you are at and where the mission is going. Which is why I said if it is critical for fusion mission of FES. I agree this should be done as a collaboration otherwise.

Comment (via chat): I think the tokamak à configuration variable (TCV) handles their ops time in a hybrid scheme: a percentage from EUROfusion, a percentage paid from Swiss government. the latter can be allocated with more freedom according to changing research priorities.

Comment: Universities do not always have the funding or people to integrate diagnostics into user facilities, and so they depend on whoever is running the user facilities to run that. This is a topic that has come up more broadly, and I would like to avoid that when we do private partnerships. Not every university has large machine shop/technical people on sire.

Comment: Installation of equipment of facilities may require support by the host facility and may require financial support.

Question: It is hard to place a value on run-time, so what about the notion of in-kind contributions? Arrangements could be negotiated, maybe even run-time on DOE facilities.

Comment: This is similar to how this is done with the international programs.

Comment: The Office of Science had collaborations with so many others, but they do not pay for run-time. In general, the U.S. did not pay for run-time on Joint European Torus (JET), and that was always somewhat of a contention.

Charge Question 14: Understanding the uniqueness of each facility, are there any general principles that should be applied to determining experimental 'ownership' of a research project?

Comment: If you own a research project, then you have the right to publish.

Comment: Part of the RoD should be a publication plan: who decides what gets to be published or presented? That is ownership. On the public side of things, I've never run into that problem working with collaborators, and I hope I would not run into that problem on the private side, but it is important to clarify that role. Publishing is the bread and butter for universities, and publishing is an important component of universities.

Comment: There is a convention on DIII-D where the session leader determines who publishes what for each experiment, and that model may not work here because it is a little more of a complex arrangement.

Comment: I think it needs to be clarified early in the RoD.

Comment: The publication plan, who presents the material, and who published the data needs to be clarified in the RoD.

Question: What if unintentionally there is IP or something that could lead to IP that comes out of this? What if you learn something that could result in IP? That needs to be clear in early agreements how this is handled.

Comment: The Office of Science a different model for international collaborations.

Comment: IP is a huge issue, and if there are conditions with IP that the company does not like, they will not go through with the proposal. Companies should weigh in on this language. IP can get complicated between universities and the private. This is a complicated issue that is important to get right.

Charge Question 15: What fraction of operational private facility time could be available for public researchers? How might this availability evolve as company milestones are reached? To what extent can 'piggyback' experiments be used?

Comment: If they are facing challenges to reach their milestone, they might bring in publicly funded scientists to help them out. This is a question for the private sector—FES or the public sector are not in the driving seat to address this. Sometimes if you are not meeting your milestones, there can be a benefit to bringing in public experts.

Charge Question 16: What is the preferred mechanism for providing FES support for accessing private non-fusion facilities or capabilities to carry out plasma science research for non-fusion applications (e.g., semiconductor nanofabrication)?

Comment: This group does not have sufficient private sector representation to answer this question.

Comment: Within the FES public part, we do not have the connections to the no fusion sector. I do not think we have as good a connection to the support industry. The University of Illinois Urbana-Champagne has a large low temperature plasma center, and they have made their university facilities publicly available for semiconductors and the microchip industry.

Comment: The preferred mechanism for me is private industry working directly with universities, leaving FES out of it. Is it any different from the rest of the system? Maybe there is no difference as to how we would approach the support for this and the other one.

Comment: There are some things that can benefit plasma research that are not plasma physics. For example, I have an SBIR to develop large vacuum chambers for fusion or high vacuum applications. If I were to submit this proposal to a typical FES call, it would not get

funded because it is not basic plasma science. However, it has a connection to the development of plasma science. Perhaps this charge question is trying to capture a bit of this in here.

Comment: Most non-fusion facilities might be operating at a higher TRL level, and as Diane said applied science may be rejected. One input here would be to broaden the scope to include some of the more applied aspects of basic sciences.

Comment: This would require increasing the breadth of FOAs in general plasma science and include advanced technologies. An example might be advanced manufacturing and supply chain issues.

Comment: I think this would partially be manufacturing or supply chain for things that you will need to get to fusion, but it is not fusion. Another example is isotope separation. I think there is a need for something like this for people to develop these technologies in the U.S..

Comment: Apart for this, most of what we have said in the prior questions applies to this topic. Once you get the scope right, the general principles would apply.

Comment: One of the FESAC reports talked about game-changing technologies, and that might apply to some of these issues.

Foundation for Energy Security and Innovation (FESI) Presentation, Mary Yamada

[Presentation posted]

Discussion

No discussion.

Full Committee Report Out

Virtual Group Report Out

Rich Hawryluk: Our group was largely made of people from the public sector, so there are some questions we may not be able to answer. For Charge Question 1 related to partitioning the data, we felt that three levels of data need to be addressed. Proprietary data needs further definition, and would negative results be classified as proprietary data? We think they should not be, and it should be in the public domain, but what is proprietary data needs to be resolved in the licensing agreement. User access as part of the agreement needs to make sure that data is shared and made available to the publicly funded users. There was a discussion that all data that was publicly funded should be made publicly available after an agreed upon duration, which may be several years even, but we do not have consensus on this discussion.

For Charge Question 2 related to the mirroring of data, there was a tension between making data publicly available if a company goes bankrupt, and preserving IP if the company wants to sell those results or potentially restart. An embargo timeline may address this, but this warrants further thought.

For Charge Question 3, if a repository were not available, a licensing agreement would be necessary to ensure access.

On Charge Question 4, FES should support maintenance of the public data repositories since it benefits the public community and would ensure standards and address IP issues. Of great importance, we feel we should reduce barriers focused on the private companies to ensure that the data is available. Additionally, ensuring that the metadata can be used first by users and

then when it is publicly available is critical and it should adhere to FAIR standards, and this should be a requirement for the companies and the collaborators.

On Charge Question 5, our group did not have much private company representation, but we recognize that culture varies in different companies. This requires more discussion.

For Charge Question 6 related to access to data, this is a fundamental tenet and is absolutely critical for publicly funded researchers. A short review process for publication should be agreed on. We also recognize the value of the review process and encourage it to make sure the quality of the results is good. We support the idea of making this data available.

For Charge Question 7, the collaborators should be an integral part of the team, which requires openness, active inclusion in the larger team, and contribution to the goals of the facility. It is part of sweat equity to make sure that the facility makes progress. Safety roles and responsibilities are dependent on the laws of the host and collaborators, and DOE addressing this in an umbrella agreement may be useful so that companies do not have to have an agreement with each lab or university separately. There are complications because this may be affected by state laws.

For Charge Question 8, flexibility for the collaborators to work on different topics in an evolving world is critical. This should be facilitated in the funding agreement and not require modification of the grant. Can the FOA be focused on expertise rather than topical area? This might facilitate flexibility, and the expertise can be more readily addressed.

For Charge Question 9, we see a need for supporting a diversity of fusion research (different concepts, levels of development and non-fusion such as technology facilities). The choice of facilities should be related to the priorities in the LRP. The review should take into account the scientific and technical capability of the facility to support the research objectives and be successful. We did not understand the implication of a tiered system based on $nT\tau$.

For Charge Question 10, as the example of ST40 indicated, this has occurred and the expertise in universities, national labs and industry should be harnessed to achieve this including the use and expertise of computer codes. The solicitation should enable universities, national labs, and industry to apply on a level playing field. They should all be engaged.

For Charge Question 11, the proposers should make available to the facilities their expertise and interests and the facilities should make available their topical areas of interest and expertise required at the beginning of the proposal process to expedite coming to an agreement as to what a strong proposal is.

For Charge Question 12, every proposal should have a PIER plan with clear deliverables and go beyond that. Community plans (such as APS) and codes of conduct would encourage positive professional behavior and be very valuable.

For number 13, If something is critical for the mission of FES, FES should be able to buy run-time, or another approach might be to provide in-kind contributions. An example of that is our support of Wendelstein 7-X (W7-X) through in-kind contributions as opposed to paying for runtime. The proposals for conducting research could identify payment to the company for run-time, which is another way of doing it and in some ways is the reverse of the way National User facilities do the work of companies. A preferred modality is that the work is beneficial to the company and the collaborator and would be a win-win situation.

For Charge Question 14: the publication plan, who presents the material, who publishes the data needs to be clarified in the RoD. If the results result in IP, the ownership of the IP needs to be clarified in concert in concert with the companies. IP is a complicated issue to get right, but you need to have clarity at the front end.

Our group did not have the expertise to address Charge Question 15.

For Charge Question 16, this would require increasing the breadth of FOAs in general plasma science and include advanced technologies. An example might be advanced manufacturing and supply chain issues. We thought the answer to question 13 applies to this topic.

Group A Report Out

Josh King: The first thing we discussed regarding data repositories is the importance of publicly sponsored simulation that involved private data—that must also be made available back to the private companies. This is to ensure that the private companies also benefit from the results of the science that they enable. For example, say gyrokinetic codes or Scrape-Off Layer Plasma Simulation (SOLPS)—these are codes that if they are validated against a private facility's data then the private company should also benefit from it.

There was a comment about a statement of support for open-source codes as a general thing that could be valuable, maybe in a solicitation. If private data is used to improve the codes, the private companies deserve assets. This is an example of a win-win situation, and atomic data is an example of an instance of this. A culture of collaboration makes it clear who gets to publish what, and establishing the culture early on makes it possible for the best possible outcome. It is important to have a defined escalation path as part of a data management plan can address issues. Data integration may need to be spelled out ahead of time with private companies to ensure new PFR diagnostics are able to be validated.

One of the alternatives of data repositories was the notion of simply having publication rights without veto. If a company acknowledges that they will not block publications, then that is an alternative to storing all of the data in a repository. A third-party escrow and the stipulation of a criteria for which the actual data would be made available in an option—this is a "break in case of fire" situation. There was a need for an upfront agreement on the research space and scope so that the areas are known ahead of time.

We also discussed the provision for delaying publication in the event that there is some IP associated with it, as MIT has done with CFS coils. MIT has ultimately published and presented numerous papers now, but there was a period where CFS could get IP settled. The data repositories are considered a scope that is outside of the company's purview and should be supported by this program.

On Element 2: Solicitation, having experienced people around when a private experiment operates should be folded in explicitly into the solicitation. The focus could be on physics operators early on and operation support. There was a point about the length of terms of awards and noting that with INFUSE it is not possible to support graduate students but with this program it could be an option with long-term awards. However, there is need for flexibility for each company, but that longer term option is important. Even though the public sector is being sponsored, it is necessary to have a private company counterpart. Having a one-team approach and putting this in the record of discussion ensures that working level experts are identified on the private company side. That said, co-apply is not desirable because it would be too high a barrier to entry for private companies. There was a concern about inundating private companies with records of discussion and the notion of doing some kind of down selection at an early pre-proposal stage. It was reiterated to upfront establish the research goals, what is in and out of bounds, and possible communication plans (while still ensuring the research goals are malleable

and allow the researchers to pivot). Multi-institutional collaborations may not be ideal. We should consider the possibility of technician and engineering support as part of these efforts as long as they are focused on delivering research ultimately.

The tiered approach did not resonate with our group; multiple people stated that there could be adverse impacts to this approach. There was a comment that the public programs should pick the private companies they are working with prior to a solicitation so that this does not create unnecessary work for companies. For DEIA, one important comment was that considering it necessary that the private companies at the very least engage openly in RoD with any person who is applying even if they do not have a high probability of success. Just that engagement would have a benefit and may allow for improvement.

For Element 3 and the modalities: a number of other models were identified for consideration, such as the JWST, MST-1, privately owned large ground-based telescopes, Keck in Hawaii, LaserNetUS (and specifically how FES operates in this space), NLUF, and SBIR and Small Business Technology Transfer (STTR). Within this modality space for runtime, public taking over a large share of the runtime could be beneficial for both parties because there is a large capital investment. If the federal government is able to purchase runtime (or purchasing an entire facility outright) this could be valuable for the private company. Private companies need to move on to their next step facilities, but they also want to retain some of those original facilities. By engaging people in these facilities and being able to keep them in the portfolio for longer, it is ultimately a benefit to the private companies as well. The example here was CFS and their Toroidal Field Model Coil (TFMC) test stand, which they continue to use despite it originally just being intended for one purpose. The notion of phasing things where you could have capability teams with operational expertise, and then once they've done the necessary conditioning, moving on to the scientific researchers. This is what = happened organically with the ST40 model. The aspiration that we would hope for is getting to a level of program integration where joint research targets could be established—where physics gaps or tech gaps are being closed across both public and private facilities.

The notion of DOE getting involved with facilities prior to completion of their construction or design with a mind for considering the life of the facility beyond their initial uses could have impacts on design that ultimately make those facilities more useful for fundamental science. We had a couple of comments on semiconductor nanofab and recognizing the 5–10-year fundamental timescales for that. Typically, universities receive a lot of this hardware through gifts. Already, there are existing collaborations through CRADAs with national labs that allow for this mutually beneficial work to take place.

Group B Report Out

Colleen Nehl: For Charge Question 1 we discussed the partitioning and sharing of data proprietary and non-proprietary data, and a company in the room presented a supply-chain perspective that the data is necessary for some tools like ML. Open-source data could be quite enabling, but this requires trust. We discussed game theory and collaboration or competition. An important question is what are we trying to solve with this question, and will companies agree to this data sharing? It will probably depend on the return on investment for this data sharing. We talked about the parallel of a material property database.

For Charge Question 2, one point made is that the data may have residual value (such as being sold by the creditors). Could this be part of a contract or standardized in some way?

Mirroring is probably not the right term, and it could make companies or their investors nervous. We should think of this from a disaster recovery perspective, where it might be good to have the data offsite. Data escrow is an option. We also need to clearly explain which problem this charge question seeks to address.

For Charge Question 3 on alternatives to data repositories that can achieve the same protections, it is clear that we need to define protections. Our room noted that storage is cheap, but retrieval is less cheap. Data repositories at labs/universities may be preferred by some versus giving access to public researchers. It was clear that it needs to be reciprocal. If the companies put data into a repository, then the public sector should also put in data. The opportunity for collaboration around code validation and benchmarking is very valuable, and companies will probably build their own alternatives to repositories anyway.

For Charge Question 4, we need to understand the underlying assumptions around this question—Is DOE the right entity to maintain this? Our group discussed how lab hosted databases have been problematic in the past. The framing for this question is important.

For Charge Question 5, our group edited the question to read "Is there private company interest in sharing some specific data openly, even in the absence of an initial public collaborative research effort?" The private companies prefer to scope it as sharing some specific data openly rather than marrying it. There are a lot of subtleties we need to consider. There could be public good reasons to share data in the future. We may want to share data to spark interest or collaboration (but maybe not all the data, or it may be embargoed to preserve competitive advantage). Do we need to set up data containers for specialized categories, disruptions, or failure models? Companies could contribute to a specialized consortium database in exchange for access to that database. The public could have access, but maybe the private need to contribute to get access to the data. And a question from the private companies was will the public data go in, will Tokamak Fusion Test Reactor TFTR data and CMOD data be uploaded? And we need to consider the security and export control issues for all of this.

For Element: 2 Solicitation, we were in agreement that the probable publication should be scoped as early as possible. There should be a publication plan established, and we should think about ways to give credit for public sector researchers for helping besides publications. Credit for publications is important for tenure at universities. There are established models for publishing as well that we can use, and there is a relevant prior art in the fission space that we can take a look at as well. We were clear that there will be restrictions placed by the company (some sort of boundary on topics is likely to be established—not just intent), but we disagreed whether the restriction should be mutually agreeable. It probably will not be, but if you cannot come up with some agreement on is publishable and what is not, then maybe it is not the right collaboration for the right people. It was clear that matchmaking and visibility would be very helpful for the public sector to find out which companies to collaborate with.

For Charge Question 7, private companies were clear that they are used to visitors, and some already have existing standards that could be applicable—and an "affiliate" status model could address safety and liability.

For Charge Question 8, it was clear that everyone was ready to move quickly, but the question is how. ST40 is an example that already has a flexible CRADA in place. Also discussed was having Indefinite Delivery Indefinite Quantity (IDIQ) as a contracting mechanism, where there is a blanket agreement in place and then you add tasks as scope evolves over time. There are models we can look to from the U.K. or Germany. Flexibility can be a challenge for private companies, and data rights can occur all types of costs. There was some debate about whether

you would want a tightly defined program that is quickly set up. It is not one-size-fits-all, and the group noted that it is about establishing boundary conditions.

For Charge Question 9, nobody liked $nT\tau$ as a metric. People doing fusion-relevant but not plasma-based work are important too. An interesting idea is that risk and reward could be a more useful metric.

For Charge Question 10, institutional COI may be a consideration. There are some complexities about the university sector engagement with private companies.

For Charge Question 11, the group recommends open communication before FOA. Beyond RoD, a letter of intent before and a letter of support after. It is important to loop in decision makers to ensure alignment.

For Charge Question 12, many private companies are very strong in DEIA, and DOE can help make lists and directories available to help find diverse and varied collaborators.

For Charge Question 13 related to modalities for providing FES support, it is clear that FES is not the only relevant entity. NNSA also has unique facilities that could be useful, and Kairos has some capabilities that could be useful. It is important to find who pays for what. Reimbursing the private sector is harder, slower, more complex, more encumbrances, and nobody wants to calculate the cost recovery. Cost recovery is complicated. It is also not just fusion devices—we want neutrons too for materials testing. There could be a potential COI if a public researcher wants to publish results that could be damaging to a company. We can also look to international collaborations and consider things like equipment donation when older machines are decommissioned.

For Charge Question 14, we agree that it is helpful to pre-negotiate upfront and have the project clearly defined. If the institution owns the research (as many public institutions do), then would the private facility own the research? What if FES pays for a diagnostic. We also need to define "ownership" of a project, and ownership means accountability and responsibility and return on risk. These issues may be addressed in existing contracts.

For Charge Question 15, the timeline for the company getting reasonable returns is not necessarily the same as delivering scientifically relevant results. A piece of equipment may be necessary for company milestones early on, and then maybe later it can become more available for public sector research. It is not so much about time, but what needs to happen when. Tiny awards may not be worthwhile. Would DOE bail out a failing fusion company if we wanted the facility? This is not a question for me but is it an interesting question. Could a company accept public support to build early on in exchange for later access or runtime for public researchers? Rather than giving an ownership stake to a new investor, they would give up for example three months of run-time to FES in exchange for money or a specialized equipment contribution from FES. Piggyback diagnostics may offer tremendous value, but they may represent their own challenges (diagnostic validation, time spent tracking down ground loops, can add days or weeks to a simple experiment, etc.).

For Charge Question 16, we were clear that fusion relevant capabilities may be relevant elsewhere. There is a need for target fabrication, and it may be useful to have more companies working in this space. There are many other cases where multiple suppliers may be useful. Investments in lasers or pulsed power could lead to applications in other markets. We would love a table of expertise and needs so that companies can help find each other and find the right public sector researchers. FES can assist with introductions to other government agencies with needs, such as in the case of magnet manufacturing.

I wrote a Charge Question 17 “How can PFR help with workforce issues?” Answers include student projects, public sector-funded internships at private companies, private Science Undergraduate Laboratory Internship (SULI), mentoring, on-ramps and offramps for careers in fusion. We should think carefully about how this program idea fits into what the national labs have that address entrepreneurial leave or sabbaticals. Do we want to encourage this back and forth, or is it a risk that public employees will leave for private sector? Mentoring takes effort, and we want to acknowledge this labor. Apprenticeship models also have a role, and we want to be inclusive about this. This must include technical staff, for example through apprenticeship models, trade schools, and community colleges. We also discussed consortiums.

Group C Report Out

Carlos Paz-Soldan: For Charge Question 1, we thought it was highly case by case for different experiments of different levels of maturity. The IP nature of the plasma is very different across companies, and some company members indicated that they might bracket the time domain so that maybe nothing during the formation stage would be disclosed but things during the stationary phase would be disclosed. Plant data would likely not be shared, plasma diagnostic data would be more likely to be able to be viewed, and the final tier of data would be things that could be published on (which may be assessed on a case-by-case basis or by the terms of the parties).

For Charge Question 2 on data mirroring, the concern was the potential for company secrets to be revealed. There was a distinction made about mirroring offsite and a legalistic right to access the data. The structures that are put in place should address the root concern, which seems to be making sure that we are not locked out of future data. The path chosen may not be the only path to get there.

For Charge Question 3, we thought that there were alternatives. Legal protection is an important one, so perhaps the company could maintain some level of hosting for the data but there could be legal protections and agreements in place that would give recourse for the government to go after the data if they did not have access. We pointed out that many of these concerns were not considered for existing user facilities in the DOE public programs, in particular the end-of-life data for CMOD was a bit ad hoc. Creating a different bar for private companies may be a bit unfair.

For Charge Question 4, we thought that FES should pay if it is separate and decoupled from what is set up by the company. If it is a separate repository in a different location, then this is a new burden on the company and that should likely be shouldered by DOE. We discussed the level of staffing that was needed at different places and came up with a handfuls of FTEs, but we are not exactly sure how much needs are there. There is a distinction between the setting up the repository infrastructure and the handholding required for people to get use out of the repository (which is more like an IT support function).

For Charge Question 5, AWS was cited as something private institutions are already using to backup and protect their data. There are commercial solutions to this problem already.

For Element 2, Charge Question 6, we were clear that publications were an important part especially for university engagement with any entity. The terms at the university-level will include some right to publication, but this does not mean that there are not IP clearances or things of that nature as part of an agreement. The data should be able to be published as long as it is scientifically valid, regardless of if companies like or dislike the results. The commitment to

open science and publication varies quite a lot across the private sector. Some companies are open, and some are closed. Having commitment to publication for scientifically valid results is important. There will be more barriers to jumping topic in this kind of program than in a publicly funded open science situation—there will probably be more stove piping of programs and more difficulty hopping to a different thing. If there are discoveries throughout the process, there are questions around ownership and IP; if a discovery were to happen maybe the company would get that as part of having created the facility.

For Charge Question 7, there is an assertion in the question that "Public sector experimental collaborations are expected to have an appreciable on-site presence." We identified two modalities for participation: a transitional interaction with the company (for example someone who shows up and benefits from a radiation stream and then leaves) and an embedded team member (analogous to ST40). These are two different ways of doing business, and those would probably benefit from being two different tiers or structures within the program. Frameworks are already in place for some interactions for onsite in access; for example the CFS affiliate program is relatively mature. Frameworks and NDAs have to be in place to prevent issues, and information protocols must be in place before onsite presence. Similarly, safety and data access concerns are also common to the public sector, whereas information sensitivity is a bit of a unique facet for the private sector.

For Charge Question 8, we discussed that flexibility is really important. Within a topic there needs to be flexibility. ST40 is an example of how a topic shifted throughout the project. It is important to keep up with what the company is doing and to be able to identify scientific opportunities as they emerge. Trust is an important part of this, and the private sector partner has to trust that the public sector partner is going to do the right thing scientifically and pursue things that are scientifically valuable, even if they are shifting based on what the capabilities of the facility are at that time. Things that are evolving include what diagnostics or operational conditions may be available on a particular day.

For Charge Question 9, we were not too keen on $nT\tau$. Other numerical metrics were identified including DPA for radiation exposure situations, the level of capitalization in terms of Seed vs Series A round, the size of facility staff, and how long until the next milestone is reached. The tiers themselves can exclude people if not done carefully, and we interpreted the goal of tiering to be to actually broaden inclusivity.

For Charge Question 10, this is a two-way street. The private sector can also bring value to public sector utilities, and we should not discount the value that private teams will bring to user facilities in the DOE environment moving forward. Many private sector players have a lot of competencies. The public sector can bring familiarity of operational modes and regimes and depth of expertise. Diagnostics were identified as a key capability that are more difficult to translate into a small private sector type environment. Open-source software and high-performance computing are strong values that public sector developers can bring to the private space. There are low barriers to the private sector adopting and contributing to open-source software. Workforce development is important and is something the public sector should bring to the private sector.

For Charge Question 11, we thought a topical interest statement would be a way for the company to lay out its vision and guide the research community. The RoD itself is not enough to understand mission need, and there would likely be a discussion between the private company and DOE project managers to make sure needs were aligned.

For Charge Question 12, something we can do in addition to the PIER plan is discuss data fairness aspects. The way the data is presented can be important for inclusion and accessibility. If enough users are operating at a single private facility, you might consider something like a user board that exists on public facilities. R2s and MSI can explicitly be promoted. Encourage balanced/diverse proposals to address balance gaps downstream. We also mentioned community benefit plans could be requested of the companies, more at the engagement with DOE pre-FOA.

For Element 3, Charge Question 13 and 14, this goes back to understanding what the users are really like—are they light source members or are they team members? Are they expected to be a customer or a provider of services at the facility? The two modalities have different expectations, and it depends on what you need. If you are a more of a technology test stand, then you might be more of a recipient of radiation to test your concepts.

For Charge Question 15, it was commented that for milestone-driven programs there is little dedicated runtime to support basic and exploratory science. The time of the machine will be to a high level focused on the missions of the facility that then satisfies what the private investors want the companies to do. We discussed is this piggyback enough, and it depends on the scientific questions to be answered, the novelty of regime, and the available of measurements. If you have a new regime, good measurements, and an easy question, then you are good with piggyback. If you do not have all of those three things, then maybe you are not so good and you would like some dedicated scans to be able to advance your topic.

For Charge Question 16, we thought the NSUF model applied well as a way for receiving radiation or doing technology demonstrations. There was a comment that for plasma semiconductor science there are a lot more embedded IP concerns which requires further exploration.

Off-script questions include a discussion of NDAs and how they would be engaged as part of the FOA. Perhaps after an award, the recipient would go down the path of a CRADA or an Intellectual Property Management Plan (IPMP) that would include terms for the non-disclosure. Many of the private participants expected nondisclosure agreements to be part of the game, and some of us were surprised by that. We discussed the duration of the FOAs, and some members liked the quick INFUSE model while others prefer longer models. Ultimately it depends on the needs of the company, and this will impact which institutions apply. We had a case study about how to manage the creation of new information, and example was made that the MIT lithium pellet injector came to TFTR to do polar imagery, but it discovered lithium wall conditioning. This is a case study of IP ownership and new idea generation in a private facility. Intellectual property management plans with companies can get messy. We also discussed do the users organize in any way, and we were not sure if NSUF have a user board? If there are enough users attached to a facility, the user organizations often address quality of life issues, publication plans, fairness issues; it might make sense to do something like that depending on the scale of the operation at certain facilities.

Final Discussion

Comment: If you start accumulating a large user base, there are a lot of FTEs associated with managing that. There is another dimension which needs some thought.

Comment: Part of this meeting is to generate information that you can use, and $nT\tau$ is an example of a bad idea.

Comment: There was a lot of harmony in our group, which was constructive. The intent is that all of this input is being captured, and we will use that and post it. I think we have a ton of material here, and good answers to questions. We brought up the ST40 model, and that is a model that worked. The worst-case scenario is doing that but as a program, and we have information that allows us to adjust what that program is.

Comment: The charge questions were written in a certain way and did not have a lot of private input. For instance, it takes a lot of maintenance to maintain the database. From the physics community, we can tend to think databases are easy. There was a talk about open-source software, and I would caution that there are a lot of start-up companies which are based on software. I have them on a multi-institutional proposal, and their software is not open source. By trying to encourage open source, we may push out talent that is not in that vein. I'm using software as an example. We may want to look at the models that the emerging companies are using, because we want to see the private side of fusion flourish.

Comment: When we did not agree, we made our differences in opinion clear.

Comment: We can hopefully use this information to deploy a program, and then revise and improve the program going forward.

Comment: Many of the questions were geared towards making the program attractive for the public researchers, but DOE must structure the program to be attractive for the private companies as well. If it is onerous, then the private companies will not participate.

Comment: The other element we discussed is the timeliness of the program—the ability to get results in the timely manner and the overall movement of the fusion sector. You cannot award a private facility use, and the administrative end of things consumes some of the timeframe. We can do things in a more efficient manner.

Question: How big does this program need to be to make it worthwhile? I'm not clear how big this program would need to be, but it probably needs to be pretty sizable to make it worthwhile. Congress gets to decide, but what the administration proposed sets the negotiation.

Josh King: Right now, the aim is to move from a pilot project (ST40) to a pilot program. I hope that as we proceed, we continue to engage and grow this program to a size that is appropriate.

Question: Our virtual group had representation from small companies, and it was a good reminder that one-size-fits-all does not work for everyone. On what timeframe do you think you will be standing up such a new program?

Josh King: We do not have a budget in FY24. The notion of providing a timeline for deploying the program is not something we can offer. The hope is that we engage with it in earnest.

Comment: There are a lot of overlaps between this program and what we do in our international collaborations. ST40 is an international collaboration. It would be good to take the best pieces from our most successful international collaborations. That will also give a clue as to the right size to get started, and I name W7X as an example.

Comment: We recognize the magnitude of the challenge that fusion presents, and I think that it is important to set the grand scale of vision and not think too small.

JP Allain: If we ask who is going to be part of standing up the fusion industry, it includes the developers but also government. The numbers for the lift to realize fusion are large.

In the public program, we have to make sure the narrative is looking beyond what we are accustomed to and be able to explain why the scale of the numbers are the way they are. The idea is for us to think about how to grow these programs in a way that is effective.

Comment: It was not easy for universities and people from smaller companies to participate in this conversation, so what was discussed may have missed some voices. Looking at question 17 on Colleen's slides, workforce development is not going to happen just with the R1 universities we have now.

Josh King adjourned the meeting.

Respectfully submitted on March 14, 2024,
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