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National Strategic Computing Reserve Tabletop Exercise After Action Report

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Executive Summary

At the beginning of the COVID-19 pandemic, the High-Performance Computing Consortium was assembled to make available advanced public-private high-performance computing resources for COVID-19 research. Following the success of this effort, the National Science and Technology Council (NSTC) put together a blueprint for a National Strategic Computing Reserve (NSCR) that could provide similar advanced computing resources during crises (NSTC 2021).

As a continuation of this effort, in 2024 the Science and Technology Policy Institute (STPI) was tasked by the Networking and Information Technology Research and Development Program's National Coordination Office to hold a tabletop exercise (TTX)—a facilitated discussion framed by a scenario meant to draw out the insights of participants. The research questions this exercise was meant to explore included the organization of the NSCR, the nature of successful NSCR operations, and obstacles to Federal agency involvement.

On August 21, 2024, STPI assembled 20 experts, primarily from government agencies, to discuss the NSCR. Group discussions entailed three exercises centered around two scenarios: a large-scale liquid natural gas leak and a volcanic eruption in the Pacific Northwest.

STPI qualitatively analyzed the results and data produced by the TTX, arriving at three findings and two recommendations for next steps. STPI's findings were:

1. The NSCR could fulfill many roles across crises of different scales or operational versus research functions—several options were discussed but a final focus for the NSCR remains to be determined and will inform NSCR organization when it is known;
2. Successful non-crisis operation of the NSCR could include serving as a repository for relevant information; a coordinating entity with detailed knowledge of existing and potential interagency cooperation mechanisms; and a communicator of the value of advanced computing capabilities during crises, such as high-performance computing, cloud computing, data, software, trained workforce, workflows and more; and
3. A lack of proper authorities would be a major obstacle for NSCR/agency cooperation, and those authorities should be put in place prior to crises.

STPI's recommendations for next steps are to:

1. Hold regular follow-up TTXs—similar in structure to the Federal Emergency Management Agency's functional exercises—that use detailed scenarios to delve further into the specific requirements for applying advanced computing capabilities to crisis situations, obtaining required agency authorities, and addressing the needs of specific crises; and
2. Bring additional partners into the discussion by:
    a. Soliciting input from additional stakeholders—such as those in academia, the private sector, and those involved in the administration of emergency services—to determine requirements for their participation in or use of the NSCR, and
    b. Conducting broader community engagement events to assess the readiness of computational decision support capabilities for the U.S. Government.

Contents

1. Introduction

This report documents the National Strategic Computing Reserve (NSCR) tabletop exercise (TTX) held at the Science and Technology Policy Institute (STPI) on August 21, 2024.

A. Overview

1. TTX Goal

A tabletop exercise is a discussion-based event where team members explore their roles and responses during a specific crisis scenario. A facilitator, in this case STPI, guides participants through structured discussion of one or more scenarios (Department of Homeland Security 2024).

The goal of this TTX was to discuss the development and operation of the NSCR both prior to and during crises. Participants provided insight into the NSCR through a range of TTX activities across two crisis scenarios. This insight was used to develop recommendations that contribute to the development and efficacy of the NSCR.

The NSCR TTX was sponsored by the Networking and Information Technology Research and Development (NITRD) Program National Coordination Office (NCO) in coordination with the pilot office of the NSCR. STPI designed and executed the TTX at its office in Washington, DC, in collaboration with IDA colleagues from the Systems and Analyses Center.

2. Research Questions

Research questions to be answered by the TTX included:

1. How should the NSCR be organized?
2. What would successful operation by the NSCR look like?
3. What are the obstacles to Federal agency involvement in the NSCR?
4. During a crisis, regarding NSCR involvement, what are the:
    a. Potential outcomes,
    b. Technical requirements,
    c. Enabling policies,

d. Resource constraints, and

e. Opportunities for NSCR improvement?

B. Background

1. Justification

In March of 2020, the High-Performance Computing Consortium (HPCC) was formed to bring together the Federal Government, industry, and academia to provide COVID-19 researchers with access to the world's most powerful high-performance computing (HPC) resources. Between 2020 and 2022, the consortium contributed to various projects, including analysis of potential drug therapies, air flow simulations, and hospital usage models (COVID-19 HPC Consortium 2022). Recognizing the successes of the HPCC, the U.S. National Science Foundation (NSF) issued a Request for Information on the goals, values, and approaches necessary for the creation of a more permanent body: the National Strategic Computing Reserve (U.S. National Science Foundation 2020). In 2021, the National Science and Technology Council (NSTC) issued a blueprint with an expanded plan for establishing the NSCR (NSTC 2021).

The NSCR was tasked with providing computing resources—including data, a trained workforce, communications, models, and community training—and bringing research expertise to bear in times of crisis to help save lives and property, and to lessen or avert the threat of a catastrophe. When the HPCC was initially founded during the COVID-19 pandemic, the primary government participants were the Department of Energy (DOE), NSF, and the National Aeronautics and Space Administration (NASA). The NSCR is meant to build upon the foundation of the HPCC by bringing together more Federal agencies to enable a broader and more thorough response in times of crisis.

The establishment of a pilot program office of the NSCR has led to renewed interest in implementing the 2021 NSCR Blueprint. Further analysis is needed to explore the relevant areas of research and the mechanisms through which the NSCR can have a positive impact. While the HPCC serves as a proof of concept for the structure of an NSCR, there remains a need for formal activation policies, modified Federal agency compute resource allocation policies, and increased interagency agreements to ensure rapid deployment of capabilities in a time of crisis. This TTX was designed to stimulate additional conversations and discussion among governmental stakeholders in further pursuit of an NSCR.

C. Organization of This Report

Chapter 1 provides the purpose and background for the NSCR TTX. Chapter 2 contains information about the TTX design and execution. TTX results are in Chapter 3, findings are in Chapter 4, and Chapter 5 concludes with recommendations for next steps.

This report also includes several appendices that provide further detail and documentation of the TTX:

- Appendix A contains a list of the participants' organizational affiliations;
- Appendix B contains the pre-TTX questionnaire;
- Appendix C contains the participant handbook; and
- Appendix D contains the digitized responses from the Flip Chart activity.

2. Tabletop Exercise Design and Execution

Chapter 2 covers TTX design and execution. It provides information on participants, scenarios, and additional details about the event. This chapter also discusses the scope of the TTX.

A. IDA Approach to Design Thinking

IDA tabletop exercises leverage *design thinking*, an iterative and non-linear process that centers around prototyping and testing to improve products for the user (Dam and Siang 2024). In the context of designing this TTX, the iteration was conducted in consultation with the sponsor to ensure the final project met their needs. On June 21, 2024, the project held a design scrum where project staff, IDA TTX experts, and the sponsor offered ideas or prototypes for the TTX design and format. Following the event, the project lead and sponsor continued to iterate on the design prototype through additional meetings and reviews until it was finalized.

Once a workable TTX was designed, a practice TTX was scheduled on August 16, 2024, with internal technical reviewers and science policy fellows. The practice run covered all three exercises across one scenario and offered the chance to stress test the design and format of the TTX. STPI volunteers were assigned a Federal agency to represent for the duration and, where available, agency responses to a pre-TTX questionnaire sent were used as background material to inform their participation.

B. Scope

This TTX was designed to foster informative discussion rather than operate as a full-scale disaster preparedness exercise such as those typically run by the Federal Emergency Management Agency (FEMA). Furthermore, since the NSCR is not yet an operational entity, the objective of the TTX was to gather information and perspectives to inform the development of the NSCR. The potential scope of the NSCR's operations is an ongoing discussion and thus reasonable for the TTX to address. Lastly, the TTX was designed to be a focused and small group exercise; therefore, not all possible stakeholders in the NSCR were included. Instead, as a first step, the TTX was primarily focused on government agencies with advanced computing resources.

C. Participating Organizations

TTX participants were largely drawn from the government computing infrastructure community, including personnel from the DOE national labs. A small number of additional participants from universities were invited. The sponsor was particularly interested in governmental perspectives at this stage, and intended to examine the role of the wider academic community or private industry in a future effort. Participants were identified by the sponsor for invitation, with a few additional invitees being identified by other participants. The full list of organizations present at the TTX is shown in Appendix A. Participants provided insights on the coordination needed for their agencies to assist in creating an operational NSCR structure.

D. Scenarios

The TTX covered two scenarios. Criteria for the scenario selection required that it include a large-scale disaster necessitating a coordinated government response and a disaster type that would benefit from compute-heavy research and development (R&D). The sponsor also wanted the two scenarios to differentiate in terms of natural and human-caused disasters and to provide a way to explore the operations of the NSCR over time. Example scenarios provided by the sponsor that met the criteria included a crude oil spill and a flood.

From these criteria, the STPI team developed two scenarios:

1. **Scenario 1:** a liquid natural gas (LNG) spill in the Chesapeake Bay centered on the Cove Point LNG station.
2. **Scenario 2:** a large volcanic eruption of Mt. Rainer in Washington State. The volcanic eruption scenario was split into two time phases:
    a. **Phase 1:** 1 week post-eruption, and
    b. **Phase 2:** 6 months post-eruption.

Full scenario text is included in the full participant handbook in Appendix B.

To craft the first scenario the STPI team reviewed the literature on large LNG spills in marine environments and found a lack of preparation for this possibility despite the recent sabotage of the Nord Stream pipeline. For scenario 2, STPI consulted with an internal subject matter expert (SME) on volcanology to determine that a volcanic eruption would meet the criteria for the NSCR TTX. These scenarios were chosen and structured to provide novel operational considerations, as well as the unique research questions that would require computational resources. For instance, the size of the hypothetical LNG leak was unprecedented and its impact on the environment difficult to predict. Alternatively, the volcanic eruption had a precedent in the Mount St. Helens eruption to provide data for advanced computing research, but was of a larger scale with a likelihood for global impacts

over years. These scenarios provided the context in which the TTX exercises would take place.

E. Event Design

After consultation with IDA SMEs on wargame and TTX design, STPI decided on a pre-TTX questionnaire, structured discussion time, and three different exercises for the final TTX design. These exercises are based on concepts presented in the work *The Surprising Power of Liberating Structures*, and are commonly used structured analytic techniques (SATs). STPI chose to use the following SATs: Rotating Flip Charts, What I Need from You (WINFY)/1-2-All (McCandless and Lipmanowicz 2024; McCandless and Lipmanowicz 2024a), and 15% Solutions (McCandless and Lipmanowicz 2024b). These SATS were selected to maximize structured brainstorming on the given research questions as well as to foster full participant engagement. The full sequence of the event, as well as descriptions of and rationales for each of the exercises, is discussed in the sections below.

1. Pre-TTX Questionnaire

Prior to attending the TTX, participants were asked to review and complete a questionnaire to enhance their involvement during the event. This questionnaire addressed whether the participant's agency was involved in the HPCC, the relevant resources possessed by the agency, and the legal authorities the agency possessed or would require to enable them to assist the NSCR during a crisis. Out of the 20 participants invited, STPI received 6 completed questionnaires prior to the event. The complete questionnaire is included in Appendix B.

2. Introductory Discussion of the HPCC

The TTX began with an introductory discussion on lessons learned from the operation of the HPCC. This activity built on a pre-TTX questionnaire that encouraged participants to consider the roles of their organizations in the HPCC and obstacles faced during the COVID-19 activation of the HPCC. It was intended to capture any useful lessons learned from the HPCC, as well as to provide a warm-up to ease participants into thinking deeply about the use of HPC during crises.

3. Rotating Flip Charts

For this exercise, participants formed groups and circulated flip charts on different topics; at each station, participants were asked to identify concrete examples relevant to each flip chart theme. After providing information for each chart, the participants formed new groups to review and brief out the findings from a specific flip chart, and a full group discussion concluded the exercise. The intent of this exercise was to encourage independent data generation and to collectively review content from the perspective of different Federal

agencies. This structure allowed STPI to quickly surface a wide range of information on the desired areas.

The four charts in this exercise covered the following topic areas:

1. **Resources**: the range of capabilities a Federal agency possesses that could be leveraged by the NSCR in a crisis scenario. These resources may include computational resources (including advanced computing capabilities), data or databases, support services, training opportunities, workforce assistance, etc.
2. **Users**: actors that could potentially use Federal agency resources while the NSCR is activated to contribute towards crisis-relevant R&D.
3. **Metrics**: the criteria by which a user request for NSCR resources could be evaluated. Metrics would enable prioritization between multiple requests. These criteria could include both general standards for high-level research design and requirements specific to a given scenario.
4. **Authorities**: the legal mandates and policies that could enable Federal agencies to deploy resources in a crisis. This topic area includes both existing authorities and potential authorities, as well as mechanisms that trigger agency involvement.

For the second scenario, the exercise was altered slightly to stimulate new data. Participants rotated through the charts twice, corresponding to scenario 2's two phases: 1 week post-volcanic eruption and 6 months post-volcanic eruption. They were instructed to label information for each topic area that did not overlap across the two time periods.

After completion of the exercise the flip charts were collected as the primary source of information. A digitalization of the flip chart information is presented in Appendix D. General notes were also taken during the group brief out period of the exercise.

4. What I Need from You (WINFY)/1-2-All

The WINFY exercise explored findings from the Rotating Flip Charts exercise and drew connections between the items placed on the flip charts. WINFY involved a guided discussion that used the results from the Rotating Flip Charts exercise to explore participant's thinking on what they require in order to act. Each question explored agency participation in the NSCR during a crisis from a different perspective. The 1-2-All aspect refers to the format of the exercise. For each question, participants reflected individually on provided worksheets (1), discussed with a partner (2), and then shared with the full group (all). The first and final component of this exercise was designed to produce capturable information on these specific questions to inform post-TTX analysis, while the partner discussion was designed to help form connections between participants and develop their thinking on the topic. The following are the questions discussed for each scenario:

Scenario 1 – LNG Spill

1. What would be required to align the resource you selected with a resource from your agency?

Scenario 2 – Volcanic Eruption

1. How would proprietary data issues impact your agency's cooperation with NSCR operations?
2. How should the NSCR deactivate following the conclusion of a crisis?

After completion of the exercise, the participant worksheets were collected for analysis following the TTX. General notes were also taken during the full group discussion.

5. 15% Solution

The 15% Solution SAT was designed to explore immediate actions that a participant, agency, or the NSCR could take in the short term to move towards greater readiness to deploy resources in a crisis. Participants were asked to identify near-term actions that they or the NSCR could take to move the agency 15% of the way toward a solution to current problems. By focusing on immediate actions and not requiring a problem to be entirely solved, this SAT yielded concrete actions and next steps for both the participants themselves and for the NSCR. Participants worked alone to complete discussion questions on worksheets, followed by a group discussion. After completion of the exercise, the worksheets were collected for analysis along with general notes taken during the discussion period. The worksheets for the WINFY and 15% Solution SATs are not included in an appendix to preserve the anonymity of the participants. However, a synthesis of the findings is presented in the Chapter 3 sections on these SATs.

6. TTX Event Summary

The full schedule of the TTX is summarized in Table 1.

Table 1. Summary of Event Design

Session	Activity	Data Collection Method
Pre-TTX	Pre-TTX Questionnaire	Questionnaire Responses
TTX Introductory Discussion	HPCC Discussion	General Notes
Scenario 1 – LNG Spill (Morning Session)	Rotating Flip Charts	Flip Charts Discussion Notes
Scenario 1 – LNG Spill (Morning Session)	WINFY	WINFY Worksheet (1 question) Discussion Notes
Scenario 1 – LNG Spill (Morning Session)	15% Solution	15% Solution Worksheet Discussion Notes
Scenario 2 – Volcanic Eruption (Afternoon Session)	Rotating Flip Charts	Flip Charts Discussion Notes
Scenario 2 – Volcanic Eruption (Afternoon Session)	WINFY	WINFY Worksheet (2 questions) Discussion Notes
Scenario 2 – Volcanic Eruption (Afternoon Session)	15% Solution	15% Solution Worksheet Discussion Notes

F. Post-TTX Data Analysis

At the conclusion of the TTX, STPI was in possession of raw information in the form of the pre-TTX questionnaire responses, flip charts, WINFY worksheets, 15% Solution worksheets, and general notes taken during each activity. STPI organized and digitized that information and then qualitatively analyzed it to address the research questions of this project. The raw information collected in each part of the TTX is presented in the following chapter. Chapter 4 synthesizes that information into key findings, and Chapter 5 suggests next steps for the NSCR.

3. TTX Results

This chapter summarizes the initial results from each data gathering component of the TTX. It is to meant to provide a sense of participants' direct contributions and thoughts. The results are then synthesized into the findings and recommendations in the following two chapters.

A. Pre-TTX Questionnaires

In the pre-TTX questionnaires, participants reported that during the HPCC their agencies took on one of the following roles: resource provider, resource user, or uninvolved. Many listed specific computing centers that could support the NSCR, and others highlighted their SMEs as being useful in a crisis. Some responses noted a need for additional authorities that would enable participation, while a few cited existing enabling rules or laws, such as the Stafford Act which is the underlying authority for most Federal disaster response activities (Federal Emergency Management Agency 2023).

B. Introductory Discussion Looking Back on the HPCC

Participants noted that getting access to relevant data was a challenge during COVID-19 and would likely remain so during any crises for which the NSCR was deployed. They also pointed out that the HPCC operated on a volunteer basis during an extraordinary situation, so the NSCR might have a different level of engagement from participants and a different degree of regularity in its protocols. Finally, the scale-down of the HPCC happened gradually and naturally as applications to use its resources dwindled, while the NSCR would likely want a coherent plan for scale-down established from the beginning.

C. Rotating Flip Charts

Each of the flip charts for scenarios 1 and 2 had numerous Post-it notes with relevant items affixed to it. A brief summary of the content of those Post-it notes is provided in Table 2 and a more complete list of flip chart content is included in Appendix D.

Table 2. Rotating Flip Charts Exercise Result Summary

	Scenario 1 – LNG Spill	Scenario 2 – Volcanic Eruption
Resources	• Specifics resources for this scenario (e.g., Defense Research and Engineering Network) • General resources included agency SMEs, advanced computing training and documentation, and data modeling or visualization capabilities	• Specific resources for this scenario (e.g., FEMA's CBRN data sharing tool, satellite imaging, weather models, and economic impact models) • General resources were the same as scenario 1
Users	• Crisis specific entities (e.g., Relevant SMEs, emergency responders, shipping officials, and FEMA) • General entities such as decision-makers, the media, and the public	• Crisis specific entities (e.g., local government, geologists, long-term modelers, or environmental researchers • General entities were the same as scenario 1
Metrics	• Specifically, experience with advanced computing • General indicators of high-quality research (a clear plan, potential impact of the research, and readiness to begin)	• Both specific and general metrics were broadly similar to scenario 1
Authorities	• Specifically, the Stafford Act, RAPID/EAGER grants, and the Economy Act • General mechanisms of collaboration (MOUs, IAAs, and DUAs) • Comments mentioned a need for greater flexibility and the ability to reallocate resources in an emergency	• Specifically, the Public Health Service Act, Pandemic and All-Hazards Preparedness Reauthorization Act, Post-Katrina Emergency Management Reform Act, and Defense Production Act • Comments again cited the need for authorities permitting their agencies to collect, access, and share data as the scenario required

D. WINFY Worksheets

Scenario 1: What would be required to align the resource you selected and a resource from your agency?

Participants noted that they would need agency agreements in place (Memorandum of Understanding [MOUs], Data Use Agreements [DUAs], Interagency Agreements [IAAs]) to access other agencies' resources; they expressed that obtaining such agreements might be more complicated than any technical issues making compute resources or

databases interoperable with one another. Others discussed the value of private compute resources, though they acknowledged the complications related to access.

Scenario 2 Question 1: How would proprietary data issues impact your agency's cooperation with NSCR operations?

Participants from agencies with open data mandates said they would struggle to share with agencies or industry requiring private data, and the converse was true for the agencies with private data. One agency in particular noted struggles around indemnification related to intellectual property, which had restricted private partnerships in the past.

Scenario 2 Question 2: How should the NSCR deactivate following the conclusion of a crisis?

Participants broadly agreed that the NSCR should scale-down gradually after a crisis officially ends, and they also acknowledged that the conclusion of a crisis may not always be clearly defined. They further suggested that the limited term for NSCR support should be made clear at the outset of all projects, and some suggested establishing official paths for transitioning NSCR research to more traditional avenues of support. However, the precise nature of the scale-down would depend on the scope of the NSCR and the nature of any given crisis to which it was responding.

E. 15% Solution

For their own actions, many participants identified information-gathering steps that would provide a deeper knowledge of the mechanisms their agency would require to move forward with the NSCR. Some also highlighted the importance of communicating the uses and needs of the NSCR to others within their agency, a task they thought the NSCR could assist with.

Regarding immediate actions for the NSCR, several participants suggested identifying the desired scope of the NSCR. They did not express a preference for anything within a wide range of potential NSCR actions, but proposed that a reasonable scope be clarified before work proceeds. Several participants also suggested the NSCR collect information to be a useful repository on agency authorities required to assist in crises, including agreements between agencies, and the technical requirements for those agencies to do so. Finally, they suggested that a follow-up tactical TTX could assist the NSCR in moving forward.

4. Findings

A. Introduction

The findings from the TTX were meant to address the research questions proposed in the introduction. To recapitulate, the research questions were:

1. How should the NSCR be organized?
2. What would successful operation by the NSCR look like?
3. What are the obstacles to Federal agency involvement in the NSCR?
4. During a crisis, regarding NSCR involvement, what are the:
    a. Potential outcomes,
    b. Technical requirements,
    c. Enabling policies,
    d. Resource constraints, and
    e. Opportunities for NSCR improvement?

The first research question was addressed through section 4.B, which discusses the scope of the NSCR and how the determination of that scope will inform its organization. The second research question was addressed by section 4.C, which discusses the successful operations of the NSCR particularly during non-crisis situations. Research question three is covered in section 4.D, which covers agency authorities as the primary obstacle to Federal agency involvement in the NSCR and touches briefly on other obstacles raised during the TTX. Finally, the multiple components of research question four were covered in different sections. Potential outcomes and opportunities for NSCR improvement were dependent on the not-yet-finalized scope of the NSCR and so were covered in section 4.B. Enabling policies was similar in practice to agency participation policies and was addressed in section 4.C.2. Lastly, technical requirements and resource constraints were beyond the focus of the participants at this stage of the NSCR's development, and so were touched upon when considering the need for a follow-up tactical TTX, which was the first recommendation for next steps discussed in section 5.A.

B. NSCR Should be Refined to an Optimal Scope from a Broad Range of Possibilities which will Inform Organization

An open question discussed throughout the TTX was the desired scope of the NSCR. There were two aspects of scope under discussion: the scale of crises required to trigger activation of the NCSR, and the functions of the NSCR once activated. Since further refinement of the NSCR's scope is required, and organization of the NSCR necessarily arises from its scope, additional exercises may be required to explore the organization of the NSCR.

1. Scale of Crises

Participants pointed out that the scale of crises for which the NSCR should be activated is not well defined. At one extreme, FEMA has over a dozen emergencies currently in effect and the NSCR should not be activated for all of them. At the other extreme, the NSCR should be activated more frequently than just for events on the scale of COVID-19. Participants agreed that some degree of regional or local disasters would likely be in scope. The NSCR will adapt its response and focus both as it develops as an organization and as new crises occur. This ongoing adjustment of scope will also have an impact on the metrics used to assess proposals.

In addition, the scale of crises to which the NSCR responds will affect the effort expended by the NSCR between crises. As participants put it, the NSCR might range from being practically nonexistent, to passively collecting useful information/resource lists, to actively holding events and building community depending on the scale of crises to which it chooses to respond and the resources available to it.

2. Operational versus Research

Participants raised the distinction between the primary role of the NSCR to either assist with operational efforts (e.g., planning evacuation routes, predicting fire movements) or assist research efforts (e.g., predicting global atmospheric impacts following a volcanic eruption). The NSCR's planned focus was on research efforts, but during some crises there may be opportunities for operational use cases. As with the question of scope, leadership will need to decide make a decision and then agencies can respond appropriately.

C. NSCR Has Three Categories for Successful Non-Crisis Operation

Participants' discussion of NSCR's successful operation focused on roles for the NSCR outside of crisis situations and three key themes emerged.

1. NSCR as an Information Repository

Participants suggested that the NSCR should compile a repository of information on both compute and non-compute resources. This could include handbooks and operational

guidance for the use of various resources, data transfer infrastructure and data storage requirements, and a point-of-contact list for advanced computing staff at relevant agencies. During the 15% Solution exercise, many individuals listed identifying those resources and following up with those individuals to start the NSCR repository.

Another category of information participants suggested the NSCR should collect included data regarding disasters. Disasters are likely to have common problems, and having a list of pre-crisis information could save time and effort. The NSCR might also identify classes of emergencies that would call for similar responses. Finally, the NSCR could collect potential use cases from users such as FEMA so that material and analyses could be prepared ahead of a crisis.

2. NSCR as a Coordinating Entity

Participants suggested that, since receiving or creating the proper authorities is often one of the most significant obstacles to interagency coordination, the NSCR could help facilitate the coordination necessary between agencies. One aspect of this effort would be to catalog all existing mechanisms for coordination that might be applicable, such as MOUs, IAAs, and DUAs. Participants differed on whether bilateral agreements between agencies or whether agencies signing agreements with the NSCR directly would be easier to implement. Beyond simply having the knowledge of interagency coordination mechanisms, participants suggested that the NSCR employ individuals with knowledge of establishing agreements between agencies, though there was no discussion of the mechanics of direct NSCR employment.

Participants also discussed how the NSCR could contribute to practical collaboration. It was suggested that the NSCR could develop mechanisms for matching resources, datasets, and models as needed by a given crisis. The NSCR could also test those mechanisms through additional TTXs for specific scenarios or the use of testbeds for general collaboration.

Finally, participants broadly agreed that next steps would require the input of private entities and academic organizations as to how those organizations could contribute to or use the resources of the NSCR. The NSCR has a role to play in developing the mechanisms of coordination with all stakeholders.

3. NSCR as a Communicator of the Value of Advanced Computing for Disasters

Participants suggested that the NSCR could help communicate the value of HPC to individuals with no prior knowledge of HPC resources and abilities. This communication might include developing slide decks and memos that could be shared with agency leadership, Congress, or other relevant stakeholders. Relatedly, the NSCR could also work on communicating with disaster experts or emergency managers who may rely on the

NSCR in a crisis without needing to understand the minutiae of HPC. In general, participants said that the NSCR should consider how decision-makers might use NSCR data and concurrently, how data could be made as clear and unambiguous as possible.

D. Authorities Are a Major Obstacle to Agency Participation in the NSCR

Coordination regarding technical issues between agencies is complicated, but can be resolved relatively quickly with a sufficient amount of attention and effort. By contrast, gaining the authority for an agency to participate in the NSCR or share resources with another agency can take months and may require legislative or executive direction, even in a crisis. The NSCR could track existing authorities and highlight the need for the establishment of new authorities for agency cooperation, so that agencies have the permissions they need to help during a crisis.

Other obstacles which were discussed by participants included the technical challenge of coordinating different agencies' resources, as well as navigating agencies' varied data and intellectual property ownership requirements. However, these other challenges were viewed as more tractable and within the agencies' ability to solve than the obstacle presented by authorities.

5. NSCR Next Steps

A. Hold TTXs Focused on NSCR Operations

The NSCR should hold regular TTXs to develop and explore in concrete detail interagency and NSCR cooperation methods and requirements during crisis scenarios.

Participants suggested that the NSCR should conduct a TTX with greater focus on the actions and interactions of agencies during specific crisis scenarios. The TTX might include either agency advanced computing staff who could speak to the specifics of advanced computing coordination between agencies, or agency leadership who could provide approval for the use of computing resources. It could also assess what networks, cybersecurity measures, clearance requirements, or DUAs might be needed in a crisis scenario. A preliminary TTX could be held to further develop the NSCR concept. Additional TTXs could be designed similar to FEMA functional exercises that "[simulate] an incident in the most realistic manner possible short of moving resources to an actual site" (Emergency Management Institute 2020), and could be held regularly to make sure the NSCR and all participating agencies are ready to operate in a crisis.

B. Additional Partners Should Be Brought into the Discussion

The NSCR should consult all relevant stakeholders—such as industry, academics, and disaster subject matter experts—and include representatives from those sectors in any future events.

This TTX intentionally focused on government resource providers as a first step to building the NSCR. However, as the HPCC demonstrated, the private sector and academia have a significant role to play in crafting a successful NSCR. Potential users of NSCR resources, such as disaster researchers, should also be consulted to determine how the NSCR could best meet their needs during a crisis.

The NSCR should conduct broader community engagement events to assess the readiness of computational decision support capabilities for the U.S. Government.

In addition to TTXs, these engagements would refine the "operational vs. research" distinction (section 4.B.2) through identifying what workflows are available and ready to run on NSCR resources and what research, development, and demonstration progress might increase the breadth of such capabilities. The capability tracking would be aided by

developing a roadmap for computational decision support with key progress indicators and priorities that could be monitored to identify when new technologies become ready for operationalization for multiple government agencies. Further, such a roadmap could also reflect community practices to move workflows from research to an operational capability.

Appendix A.
Participating Organizations

Organization	Type
NITRD National Coordination Office	Government
U.S. Geological Survey	Government
University of Utah	Academic
National Science Foundation	Government
Department of Energy	Government
Department of Defense	Government
National Aeronautics and Space Administration	Government
National Renewable Energy Laboratory	FFRDC
Lawrence Livermore National Laboratory	FFRDC
Office of Management and Budget	Government
Oakridge National Laboratory	FFRDC
Federal Emergency Management Agency	Government
National Institutes of Health	Government
University of California, San Diego	Academic

Appendix B.
Pre-TTX Questionnaire

IDA

National Strategic Computing Reserve Tabletop Exercise Pre-TTX Questions

August 21st, 2024 – 9:00 am to 5:00 pm (ET)

Institute for Defense Analyses
Science and Technology Policy Institute
1701 Pennsylvania Avenue NW, Suite 500
Unclassified | Chatham House Rule | In-Person Only (no virtual option)

Please review the following questions. If possible, return a completed worksheet by August 14th to Dylan Cohen (dcohen@ida.org) or Kush Patel (kpatel@ida.org). Otherwise, plan to attend the TTX ready to discuss your agency's answers to these questions

1. **How did your organization contribute to the operation of the COVID-19 High-Performance Computing Consortium (HPCC) and what obstacles to participation did your organization face?**

2. **What resources does your organization possess which could be leveraged by the NSCR in a crisis scenario? This could include computational resources, data or databases, support services, training opportunities, workforce assistance, etc.**

3. **What legal authorities are in place or should be put in place to enable your organization to deploy resources in a crisis scenario? (For one example of what this authority might look like, see the section on the *ASCR Leadership Computing Challenge program* in the following document which explicitly permits the use of DOE computational resources for national emergencies)**

ASCR Computational Facilities Allocation Policy

Summary
The primary objectives of the allocation policy for the high end computing resources provided by the Office of Advanced Scientific Computing Research (ASCR) in the Department of Energy's Office of Science (SC) are: to provide programmatic allocations at the National Energy Research Supercomputing Center (NERSC) for SC mission critical projects and to provide substantial allocations to the open science community through a peered process for a small number of high-impact scientific research projects at the Leadership Computing Facilities at Argonne National Laboratory and Oak Ridge National laboratory.

Allocation Programs

- *Innovative and Novel Computational Impact on Theory and Experiment (INCITE)*- Scientists from the national and international research community may request multi-year allocations for a majority of the computational resources at the Leadership Computing Facilities at Argonne National Laboratory and the Oak Ridge National Laboratory through the INCITE program (http://www.sc.doe.gov/ascr/incite). The call for INCITE proposals will be issued annually in mid-April and close in mid-July for allocations to begin the following January and will be posted at http://hpc.science.doe.gov. Successful proposals will describe high-impact scientific research in terms that can be subjected to peer review in the area of research, based on guidelines established in 10 CFR Part 605.10 which are posted at: http://www.science.doe.gov/grants/6 05index.html, as well as a general review that cross-cuts scientific disciplines. Applicants must also present evidence that in single runs they can make effective use of a major fraction of the processors of the high performance computing systems offered for allocation. Applicant codes must demonstrate readiness to run on the requested leadership computing system(s) at Oak Ridge and Argonne.

- *National Energy Research Scientific Computing (NERSC):* Researchers working SC relevant projects may request allocations for the majority of the resources at NERSC through the Energy Research Computing Allocations Process (ERCAP). The NERSC call for proposals will be issued annually in August and close in October for allocations to begin the following January. For more information see www.nersc.gov/nusers/accounts/allocations/ercap/

- *ASCR Leadership Computing Challenge program*- Open to scientists from the research community in academia and industry, the ASCR Leadership Computing Challenge (ALCC) program allocates up to 30% of the computational resources at NERSC and the Leadership Computing Facilities at Argonne and Oak Ridge for special situations of interest to the Department with an emphasis on high-risk, high-payoff simulations in areas directly related to the

Department's energy mission, for national emergencies, or for broadening the community of researchers capable of using leadership computing resources. The call for proposals will be issued annually for single year proposals on October 1st. However, proposals may be submitted at any time during that fiscal year. Proposals submitted to the ALCC program will also be subject to peer review of scientific merit based on guidelines established in 10 CFR Part 605 and to computational readiness assessments by the Centers.

- *Center Reserves*- Up to 10% of the computational resources at NERSC and the Leadership Computing Facilities are available for allocation by the Directors of those facilities. These resources will be used to support pilot or startup projects, to support code scaling efforts, and for exascale computer science and performance metrics research. The allocation process for the Center reserves are described on the web pages of NERSC, and of the LCFs at Argonne and Oak Ridge.

For more information contact:

Barbara Helland
INCITE and Leadership Computing Director
Office of Advanced Scientific Computing Research

Dave Goodwin
NERSC Program Manager
Facilities Division
Office of Advanced Scientific Computing Research

Appendix C.
Participant Handbook

Name: _____

Organization: _____

NSCR TTX

Participant Handbook

21 August 2024

IDA

National Strategic Computing Reserve:

Tabletop Exercise

Images taken from (counter-clockwise from top right): Danish Defense Command, Cliff Owen / AP, Dominion Resources, and Jim Valance / USGS

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Table of Contents

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National Strategic Computing Reserve Tabletop Exercise Agenda

August 21st, 2024 – 9:00 am to 5:00 pm (ET)

Institute for Defense Analyses
Science and Technology Policy Institute
1701 Pennsylvania Avenue NW, Suite 500
Unclassified | Chatham House Rule | In-Person Only (no virtual option)

This in-person tabletop exercise (TTX) brings together agency stakeholders to discuss the development and operation of the National Strategic Computing Reserve (NSCR) both prior to and during crises. Participants will provide insight into the NSCR through a range of TTX activities across two crisis scenarios. The goal of this TTX is to develop concrete recommendations that contribute to the further development and efficacy of the NSCR.

0900 – 0915	**Introduction:** Ann W. Schwartz, Program Manager, NSCR; Co-Chair, Subcommittee on Research and Development Infrastructure **Opening Remarks:** Kei Koizumi, Principal Deputy Director for Science, Society, and Policy, OSTP
0915 – 1000	**Participant Introductions** Discussion of agency actions during the HPCC via the pre-TTX worksheet
1000 – 1100	**TTX - Scenario 1, Part 1** Introduction of the human-made disaster scenario, explanation of the day's TTX activities, conduct of initial activities
1100 – 1115	***Break***
1115 – 1230	**TTX – Scenario 1, Part 2** Completion of scenario 1 TTX activities, and discussion of outcomes
1230 – 1330	***Lunch***
1330 – 1500	**TTX - Scenario 2, Part 1** Introduction of the natural disaster scenario, conduct of initial TTX activities
1530 – 1545	***Break***
1545 – 1600	**TTX – Scenario 2, Part 2** Completion of scenario 2 TTX activities, and discussion of outcomes
1600 – 1700	**Final Hotwash** Comparison of outcomes across scenarios and identification of next steps for both participants and for the NSCR

IDA

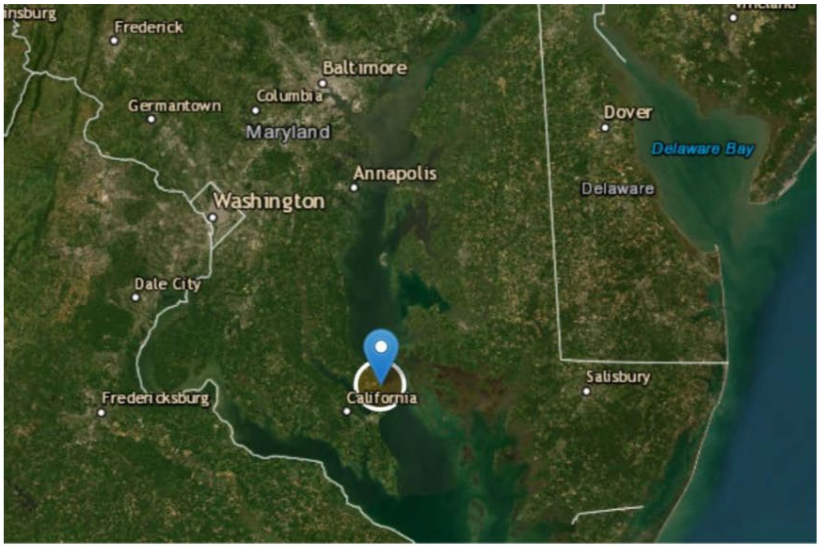
STPI Logistics

- Wi-Fi: Infinity Password: HelloSummer24
- This is an unclassified space. Please refrain from discussing any classified material during this TTX. Phones and laptops can be used throughout, but we request their use be limited to focus on the TTX.
- We will be collecting these participant binders at the end of the exercise. They will be used to generate an after-action report and next step recommendations. One worksheet will be scanned and returned.
- If you need to take a call, please exit through the rear door, turn right, and let our Program Administrator Dawn Nunnery know so she can find an empty room. If possible, please notify her ahead of time.
- Restrooms are located in the elevator lobby. Please let Dawn know because the doors will lock behind you and you will need someone on the inside to permit reentry.
- Nearby lunch options include:
  - Potbelly
  - Immigrant Food
  - Roti
  - McDonald's
  - Grilled Cheese DC
  - Chopt
  - Lebanese Taverna
  - Panera Bread

IDA

Scenario 1: Large Liquid Natural Gas (LNG) Leak

Lusby, Maryland: April 6, 2025



Cove Point is an LNG export terminal that resides on a 1,000-acre site on the Chesapeake Bay. On April 6, 2025, an accident causes major damage to the facility and a fully loaded LNG vessel, causing LNG to leak into the Chesapeake Bay. Previous natural gas leaks of a comparable scale have occurred, most notably the 2015 Aliso Canyon leak and the 2022 Nord Stream pipeline sabotage. However, this is the first LNG leak of this scale, and the impact of a large leak of a substance at -260°F is unknown.

MethaneSat, a methane monitoring satellite, records a spike in methane emissions in the region. On the ground, measurements detect elevated levels of methane across the breadth of the Chesapeake Bay and as a result shipping in the Bay, including to DC and Baltimore, is halted. Air travel in this airspace is also restricted due to potential safety concerns. There is the potential

for spillover effects to impact the Calvert Cliffs Nuclear Power Plant (5 miles away), and the Naval Research Laboratory Chesapeake Bay Detachment (25 miles away).

Federal/State/local government officials may require information or research on:

- Methods and modeling for safely stopping the LNG leak;
- Local ecological and regional climate impacts from the release of LNG;
- Nautical and aviation transportation safety risks;
- Human health impacts on communities near the Chesapeake Bay, including Baltimore and DC; and
- Differences in the impacts of an LNG leak compared to a NG leak.

IDA

Rotating Flip Charts

Activity Description:

Purpose: Gather information on resources, users, authorities, and metrics relevant to the NSCR. Flip charts will allow participants to provide input on each area independently and review content from other Federal agencies.

General Description: Individuals form groups that rotate through the four flip charts to add information on that topic. After providing information for each chart, the individuals will form new groups to review and brief out on a specific flip chart. A full group discussion will follow.

Topic Areas:

Resources: Federal agencies possess a range of different capabilities that could leveraged by the NSCR in a crisis scenario. These resources could include computational resources (including high performance computing), data or databases, support services, training opportunities, workforce assistance, etc.

Users: Actors that could potentially use Federal agency resources while the NSCR is activated to contribute towards research and development that aids in a crisis scenario.

Authorities: The legal mandates and policies that could enable a Federal agency to deploy resources in a crisis scenario. This topic area includes both existing authorities and potential authorities, as well as the mechanisms that trigger agency involvement.

Metrics: The criteria by which a user request for NSCR resources could be evaluated to enable prioritization between multiple requests. These criteria could include both standards for high-level research design and scenario-specific criteria.

IDA

What I Need from You (WINFY)/1-2-All

Activity Description:

Purpose: Explore findings from the Flip Charts activity and draw connections between the items placed on the flip charts. Discussion is especially focused on what is needed from others (participants and external entities) to enable successful deployment of resources.

General Description: Guided discussion that uses the results of the Flip Charts activity to ask questions of participants. Each question will explore what an agency would need to enable use of resources during a crisis scenario from a different perspective. The **1**-**2**-**All** aspect refers to the format of the discussion. For each question participants will reflect individually, discuss with a partner, and then share with the full group.

Questions to be discussed include:

1. What would be required to align the resource you selected and a resource from your agency?
2. What trigger mechanism would enable as many resources to be deployed as possible?
3. Which users should be prioritized and by what metrics should they be selected?

IDA

WINFY Worksheet – Scenario 1

Name: _____ Agency: _____

Question 1:

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Question 2:

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Question 3:

Notes:

Question 4:

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IDA

15% Solution

Activity Description:

Purpose: Explore immediate actions an agency or the NSCR can take unilaterally to move towards greater readiness to deploy resources in a crisis.

General Description: Individuals first work alone to complete discussion questions on the provided worksheet, followed by a group discussion. Individual answers will be collected, scanned, and returned to participants prior to the end of the day.

IDA

15% Solution Worksheet – Scenario 1

Name: _____ Agency: _____

What concrete actions could you (or your agency) take today that would move you 15% of the way towards being able to contribute resources in a crisis?

What concrete actions could the NSCR take today that would move it 15% of the way towards being able to contribute during a crisis?

IDA

Scenario 2: Volcanic Eruption

Mount Rainier, Pacific Northwest, August 25, 2025

Mt. Rainier is an active stratovolcano in the Pacific Northwest roughly 60 miles southeast of Seattle. For 2 months the region around the volcano has been experiencing earthquakes and steam-venting episodes similar in nature to those that preceded the 1980 eruption of Mount St. Helens. On August 25, 2025, Mt. Rainier erupts.

Early analysis suggests the eruption is of magnitude 7 on the volcanic explosivity index (VEI). This eruption is larger than the VEI 5 eruption of Mount St. Helens in 1980 and rivals the 1815 Mount Tambora eruption in Indonesia. Ejecta from the eruption threatens an estimated 40km around the volcano and ash falls as far away as Seattle. Ash clouds are spreading to cover much of the western United States and Canada and further ash fall in a significantly wider range is possible. Due to a large amount of glacial ice, very large lahars (volcanic mudslides) may occur across much of the region surrounding the eruption. Tens of millions of tons of sulfur dioxide have been released into the atmosphere.

Phase 1 – 1-week post-eruption

The initial eruption devasted hundreds of square miles of the landscape. Immediate disaster relief is ongoing in the surrounding region and aid has been sent in to Tacoma and Seattle. Crews on the ground are working to provide search and rescue, medical assistance, and shelter to those affected. Research needs for the moment are focused on the area directly affected by some aspect of the eruption, a large range covering 15 States and the western Canadian provinces.

Potential immediate research needs and concerns include but are not limited to:

- The risk of follow-on disasters such as additional earthquakes or eruptions;
- Short-term weather impacts for the western U.S. and Canada;
- Wildland fire impact from the eruption on existing and newly started fires; and
- Mid- to long-term health impacts from ash or other tephra.

Phase 2 – 6 months later

Mount Tambora's VEI 7 eruption in July 1815 led to the 1816 "Year Without a Summer." Sulfur dioxide injected to the stratosphere by the eruption absorbed incoming radiation and led to lower temperatures across the globe, especially in Europe and eastern North America, causing crop failures and societal unrest. Sulfur dioxide can persist in the atmosphere for up to 3 years.

Six months following the disaster, the need for immediate relief has concluded. The region is in the recovery phase, though the full impact of the disaster on the PNW requires additional research to ascertain long-term effects. In addition, as the Rainier eruption is the first VEI 7 eruption in the modern era, there are opportunities for research using modern observational and modeling technologies. The eruption's global impact is still being felt, primarily through changed global weather patterns temperatures, especially in India, Indonesia, and China.

Meteorologists' and volcanologists' proposed avenues of research include but are not limited to:

- Crop failures (and associated famine, supply chain issues, and civil unrest);
- Extreme weather patterns;
- Broad climate impacts; and
- Pollution dispersal health impacts.

IDA

Rotating Flip Charts

Activity Description:

Purpose: Gather information on resources, users, authorities, and metrics relevant to the NSCR. Flip charts will allow participants to provide input on each area independently and review content from other Federal agencies.

General Description: Individuals form groups that rotate through the four flip charts to add information on that topic based on phase 1 of the scenario. A second round will then occur based on phase 2 of the scenario. After providing information for each chart and each phase, the individuals will form new groups to review and brief out on a specific flip chart. A full group discussion will follow.

Topic Areas:

Resources: Federal agencies possess a range of different capabilities that could leveraged by the NSCR in a crisis scenario. These resources could include computational resources (including high performance computing), data or databases, support services, training opportunities, workforce assistance, etc.

Users: Actors that could potentially use Federal agency resources while the NSCR is activated to contribute towards research and development that aids in a crisis scenario.

Authorities: The legal mandates and policies that could enable a Federal agency to deploy resources in a crisis scenario. This topic area includes both existing authorities and potential authorities, as well as the mechanisms that trigger agency involvement.

Metrics: The criteria by which a user request for NSCR resources could be evaluated to enable prioritization between multiple requests. These criteria could include both standards for high-level research design and scenario-specific criteria.

IDA

What I Need from You (WINFY)/1-2-All

Activity Description:

Purpose: Explore findings from the Flip Charts activity and draw connections between the items placed on the flip charts. Discussion is especially focused on what is needed from others (participants and external entities) to enable successful deployment of resources over the different timescales of the two phases.

General Description: Guided discussion that uses the results of the Flip Charts activity to ask questions of participants. Each question will explore what an agency would need to enable use of resources during different timescales in a crisis scenario. The **1**-**2**-**All** aspect refers to the format of the discussion. For each question participants will reflect individually, discuss with a partner, and then share with the full group.

Questions to be discussed include:

1. How do the resources/users/authorities/trigger mechanisms differ between phase 1 and phase 2 of this scenario? How should those differences inform the NSCR approach to differing crisis timescales? (Short vs. long term)
2. How should the NSCR wind down and deactivate as the crisis concludes?

IDA

WINFY Worksheet – Scenario 2

Name: _____ Agency: _____

Question 1:

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Question 2:

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IDA

Question 3:

Notes:

Question 4:

Notes:

IDA

15% Solution Worksheet – Scenario 2

Name: _____ Agency: _____

What concrete actions could you (or your agency) take today that would move you 15% of the way towards being able to contribute resources in a crisis?

What concrete actions could the NSCR take today that would move it 15% of the way towards being able to contribute during a crisis?

IDA

Notes:

IDA

Notes:

Appendix D.
Workshop Response Material

Appendix D contains the output from the flip chart exercise. There were four flip chart topics: authorities, metrics, resources, and users. Each was considered for scenario 1: a large leak of liquid natural gas, and for scenario 2: a volcanic eruption in the PNW. Additionally, scenario 2 had two phases: 1 week post-eruption and 6 months post-eruption. The following tables contain the contents participants provided within each topic area for each scenario and phase.

Authorities Scenario 1
• NIH requires emergency authority for people to access controlled access data
• Ability to loan out SMEs requires MOUs
• MOUs take a long time to put in place
• Stafford Act: FEMA mission can assign other Federal Resources/Authorities after a Presidential declaration
• Impact analysis fund and insurance process
• NASA needs emergency authority to provide NASA resources to users that are not already in NASA systems
• Declaration of emergency; Reallocate people and resources
• High accuracy data
• Need update to user facility governance documents to clarify that the mission includes emergency response
• RAPID/EAGER grants (allow immediate travel, use, and access)
• Flexibility in who grants exemptions
• NSF does not own computing resource, no authority needed
• Set up authorities; Workshops and exercises
• Who decides when to trigger the reserve and who determines the threshold?
• Data and model repositories with legal authority to link and analyze data; who would serve as the honest broker?
• Data sharing; DUAs must be in place
• Authority to reprioritize workloads to give higher priority to emergency workloads
• Partnerships/alliances
• Existing interagency agreements for Department of Defense (DoD) emergencies
• Publicly accessible data
• Economy Act; Interagency agreements (in place collaborations)

Authorities Scenario 1

- Acquire data > Utilities, Transportation, Health, etc.
- Preparedness and purpose
- Is there an existing process?
- Governance structure
- High accuracy data

Authorities Scenario 2: Phase 1

- Public Health Service Act --> Pandemic and All-Hazards Preparedness Reauthorization Act
- Authority to collect and share needed data from the population
- Authority to access non-open access data (controlled-access)
- International task forces
- "Nationalize resources" (shipping, transit, compute)
- Interagency agreements
- Existing commercial contracts
- Agency mission
- Funding authorization and appropriations
- Stafford Act; Post-Katrina Emergency Management Reform Act
- Environmental agencies
- Who is the key coordinator? (Person, agency, committee)
- Who has authority to set thresholds and make the call (when there are dependencies)?
- Schools, hospitals, and workplaces
- Who makes the decisions? (Main drivers vs. support, redirect the supply chain) How do you pay for it?

Authorities Scenario 2: Phase 2

- Appropriate funding for longer term
- Potential for national emergency (section 501b under Stafford Act)
- Transition from government to market drivers
- Defense Production Act (several departments have DPA authorities)
- Transition from local to global authorities
- Economic planners/World Bank
- World Health Organization
- United Nations
- Aid authorities
- Identify actions (what can be done better/differently?)

Authorities Scenario 2: Phase 2

Metrics Scenario 1

- SME technical review
- Demonstrated ability to run at scale/process big data
- Maturity of workflow
- Cooperation readiness
- Emergency response time to solution
- 1. Impact; 2. Who is asking question; 3. What question are they trying to answer; 4. When do they need an answer
- Coordination/evaluation process; Why do important results differ? How do we compare and choose?
- Ability to accelerate a specific workload on the resource (i.e., right problem/matching a domain expert PI with an HPC expert PI)
- Can the specific request be executed elsewhere? Match need to resource
- Evaluate computational readiness of codes and models for the specific resource
- Output: interoperability and usefulness
- Triggers; Scale of Impact: area, population, cost; familiarity
- Operations (data movement, usability)
- Life safety should be a priority (if the question is appropriate for NSCR)
- Emergency phase-specific; Metrics: response and recovery
- Actionability
- Clarity of decision path
- Existing account/prior use of resource
- Security clearance/background check
- Ability to be trained/use resources
- Post mortem
- Holistic evaluation of proposals/projects; Data, model, personnel
- Need for real time research
- Stand down
- Emergency awareness; Timelines of data and models

Metrics Scenario 2: Phase 1

- Ground truth identifiers; number of casualties
- Actionable and timely
- Resources requested
- Impact
- Number and kinds of sensors; distribution of sensors
- Website hits/data downloads
- Model accuracy and runtime

Metrics Scenario 2: Phase 1
• Social media activity (ex. Did You Feel it?) • Availability and access to resource (data, compute) • Deployment, feasibility, and actionable results • Actionable information (*not nice to know) • Life safety - 1st for prioritization • Continuity of government (State and local) • Long-term effects (to minimize future probabilities) • Risk profile of different choices (framework and threshold for action) • Established workflow (validated) • Panic control and crowd management metrics • Risk of failure • Lack of other resources; supplies for responders • Contribution to understanding of the danger posed to the public • Data available; connectivity issues • Infrastructure safety • Evacuation plan • Preparedness: ready to go • Changing situational awareness metrics: visibility, open/closed roadways, air quality monitoring for health • Policy compatibility (security, etc.)

Metrics Scenario 2: Phase 2
• Continuity of government (national) • Population analysis/demographics • Iterative processes: changes with new information • Update decisions: do we keep or drop a model or a process? • Quantification of international aid and needs • Validation/verification metrics • Economic and global impact analysis • Optimization; cost/benefit analysis • Will the project complete soon enough to impact rebuild decisions • Mental and physical health recovery programs/metrics • Strength and resilience of team/workforce pipeline

Users Scenario 1	
Category (if applied)	**Post-it note content**
Experts	• Only DoD users with security clearances can run on our HPC systems
Experts	• DoD loans its expertise to other agencies as needed
Experts	• DoD develops lots of models that can be offered up but HPCMP users would have to execute
Experts	• "Subject matter experts": NSF could use the disaster data for future modeling
Experts	• Computational domain scientists in user facilities to help external users with code portability and scalability issues
Experts	• Academic researchers developing models (spread, human impacts of exposure, and human mobility issues such as evacuation)
Experts	• Federal agency researchers working under interagency partnership agreements
Experts	• On-site researchers
Experts	• International science reserve
Impacted	• Public affairs office; great engagement in media
Impacted	• Local industry
Impacted	• Public
Impacted	• Media
Impacted	• Entertainment documentaries
Impacted	• Nonprofits/advocacy
Impacted	• Market/energy supply
Impacted	• Tribal communities
Impacted	• Supply chain
Providers	• FEMA
Providers	• Satellite operators; open data users
Providers	• International partners
Providers	• Power/utility providers; critical infrastructure
Providers	• National weather service
Providers	• Emergency services
Providers	• Shipping and logistics industry
Providers	• Federal Aviation Administration (FAA)
Providers	• Fish and wildlife
Providers	• Agriculture and food authority
Providers	• Coast Guard
Responders	• FEMA
Responders	• Transportation networks
Responders	• White House/NSC/OMB
Responders	• Lead Federal agency/interagency

Users Scenario 1	
Responders	• Congress
Responders	• First responders
Responders	• Governor
Responders	• Local authorities and State governments
Responders	• Public health/healthcare
Responders	• International partners

Users Scenario 2: Phase 1	
Category (if applied)	**Post-it note content**
	• Local authorities (city, State, etc.) • Power infrastructure (and other utilities and critical infrastructure) • Healthcare providers and facilities • National guard • Geo departments at universities • Private sector examples: critical infrastructure, large corporations (energy and gas suppliers), data management • Media/public relations • "Peer" agencies or institutions such as FAA, NASA, FEMA, etc. • International coalitions (UN) • Same as before (first scenario) • On-site research/response scientists • White House "Catalysts" • Experts in existing models • Port of Seattle; Sea-Tac (Seattle-Tacoma International Airport) • Subject matter experts • Community/volunteer groups • Community mappers • Communications (tech) providers • Funders (no strings attached?): public, private • Deconflicting entity • Data curators • Utilities • Users willing to cede resources; drones: supply chain to provide them • Airlines and transport

Users Scenario 2: Phase 2	
Category (if applied)	**Post-it note content**
	• Medical equipment and pharma industry • Transportation industry • Water resource managers; Drilling companies • Strategists and planners • Futurists • Media • Environmental studies • Doctors/medical/healthcare (long-term health issues) • Long-term modelers (improved models and combination of new data) • Computational domain scientists/modelers • Farmers and fisheries • Insurance industry

Resources Scenario 1	
Category (if applied)	**Post-it note content**
Compute	• Edge computing --> robots
Compute	• DRENetwork (defense research and engineering network)
Compute	• DoD HPCMP compute, DOE HPC facilities, need PHI/PII proprietary secure computing /privacy preserve campaign; need authority to operate
Compute	• Proprietary regional clinical data to monitor phenotypic changes with respect to the energy
Compute	• Mid-scale HPC systems (Earth science focused)
Compute	• Private providers
Compute	• Immersive visualizations
Compute	• Academic compute resources via access to the NAIRR
Data	• Sharing sensors and refocusing them at borders and ports
Data	• Use of privacy enhancing technologies to accelerate data sharing
Data	• National-scale data platforms and cyberinfrastructure
Data	• Satellites and satellite data
Data	• Clinical data; Electronic Health Record data
Data	• List of research awards
Data	• Centers of excellence (for models, chemicals, etc.)
Data	• LandScan of population mobility data with regional demographics

Resources Scenario 1	
Data	• Need for data/model repositories
Data	• Mobile and fixed edge sensing and computing
Data	• Data and modeling common activities
Data	• National guard plane data
End user	• To provide questions to be answered
End user	• To validate results
Software	• Pre-tested workflows
Software	• Repositories and inventories
Software	• Interoperable and portable software/tools
Training	• Tabletop exercises that are specific for workflows
Training	• HPC training
Training	• Unique databases
Training	• Training skillsets
Training	• HPC user engagement staff
Training	• Training of AI models
Training	• Testbeds
Training	• HPC training courses
Training	• Documentation
Training	• NSCR certification programs
Workforce/Experts	• DOE, NSF, USGS, and university computational scientists
Workforce/Experts	• DoD SMEs
Workforce/Experts	• Computational scientists at DoD HPCMP
Workforce/Experts	• Corp of Engineers; SMEs
Workforce/Experts	• DOE/National labs computational and experimental SMEs
Workforce/Experts	• Communication and outreach specialists
Workforce/Experts	• Intelligence chiefs
Workforce/Experts	• Office of emergency services

Resources Scenario 2: Phase 1	
Category (if applied)	**Post-it note content**
Assets	• Mobile power
Assets	• Infrastructure planning and community assistance scenario analytics
Assets	• Immersive visualization environments
Assets	• High bandwidth communication/data networks
Assets	• Prepositioning and optimization of grid assets
Assets	• Supply chain and operational management systems

Resources Scenario 2: Phase 1	
Assets	• Alternate communications infrastructure
Assets	• Match making users and resources
Modeling and knowledge	• Existing models --> earthquake modeling to predict infrastructure impacts --> human mobility models
Modeling and knowledge	• AI workflows for climate/resource linking: super resolution; LLMs
Modeling and knowledge	• International volcanic knowledge
Modeling and knowledge	• Domain scientists and computational scientists
Modeling and knowledge	• Model optimization (this actually happened)
Modeling and knowledge	• Fire scenario and ignition monitoring
Observational sensor or human derived data	• Databases: quick-set pavements, soils analyses --> appropriate ground vehicle, respirators/class A, air monitoring
Observational sensor or human derived data	• Search and recovery for causalities; ground-level data like Survey123
Observational sensor or human derived data	• Data on power grid and other critical infrastructure
Observational sensor or human derived data	• CBRN responder field readings (uploaded to a common platform)
Observational sensor or human derived data	• Clinical data, Electronic Health Record data, real-world data including personal data from wearables
Observational sensor or human derived data	• Fine grained mobility data
Observational sensor or human derived data	• USGS sensor data: tilt sensors, UAV imagery, LIDAR data, etc.
Observational sensor or human derived data	• NASA/NOAA satellite data
Observational sensor or human derived data	• Geophysical data from earthquake sensors
Observational sensor or human derived data	• Missing person tracking tools and sensors
Observational sensor or human derived data	• HPC: DOE, DoD, NASA, USGS; mobile HPC assets
Observational sensor or human derived data	• Generate situational awareness maps
Situational awareness field data	• Social media tracking to detect human behavior
Situational awareness field data	• Data from monitoring networks like NEON, SAGE, etc. that are funded by NSF
Situational awareness field data	• Communication via emergency channels and social media
Situational awareness field data	• Flight observational data

Resources Scenario 2: Phase 1	
Situational awareness field data	• Data from international collaborations

Resources Scenario 2: Phase 2	
Category (if applied)	**Post-it note content**
Better data	• HPC/computing data centers in shipping containers and semi-mobile power
Better data	• Long-term air quality monitoring; reforestation plan
Better data	• New data sets from sensors and social media
Integrated models	• Models specific to VEI5 and AI-integrated
Integrated models	• Recovery planning tools; reestablished power grid
Integrated models	• Better validation of frameworks/workflows
Sector models and research grade	• Local and community organizations
Sector models and research grade	• Weather models
Sector models and research grade	• Famine early warning system
Sector models and research grade	• Global forecast models: water, weather, climate impacts
Sector models and research grade	• Agriculture models (farmer's almanac)
Sector models and research grade	• Economic impact models (what will this cost us?)
Sector models and research grade	• Climate change software and models
Sector models and research grade	• Public health indicators for extended term
Sector models and research grade	• Digital twin
Sector models and research grade	• Industry data
Sector models and research grade	• Ecosystem resilience analysis

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Abbreviations

AI	Artificial Intelligence
CBRN	Chemical, Biological, Radiological, and Nuclear
DREN	Defense Research and Engineering Network
DoD	Department of Defense
DOE	Department of Energy
DUA	Data Use Agreement
EAGER	EArly-concept Grants for Exploratory Research
FEMA	Federal Emergency Management Agency
FFRDC	Federally Funded Research and Development Center
HPC	High-Performance Computing
HPCC	High-Performance Computing Consortium
HPCMP	High-Performance Computing Modernization Program
IAA	Interagency Agreement
IDA	Institute for Defense Analyses
LLM	Large Language Model
LLNL	Lawrence Livermore National Laboratory
MOU	Memorandum of Understanding
NAIRR	National Artificial Intelligence Research Resource
NASA	National Aeronautics and Space Administration
NCO	National Coordination Office
NIH	National Institutes of Health
NITRD	Networking and information Technology Research and Development
NREL	National Renewable Energy Laboratory
NSCR	National Strategic Computing Reserve
NSF	U.S. National Science Foundation
NSTC	National Science and Technology Council
OMB	Office of Management and Budget
ORNL	Oak Ridge National Laboratory
OSTP	Office of Science and Technology Policy
PHI	Protected Health Information
PII	Personally Identifiable Information
PNW	Pacific Northwest
RAPID	Rapid Response Research
SAT	Structured Analytic Techniques
SME	Subject Matter Expert
STPI	Science and Technology Policy Institute
TTX	Tabletop Exercise
UAV	Unmanned Aerial Vehicle
USGS	United States Geological Survey
WINFY	What I Need from You

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14. ABSTRACT

STPI was asked by OSTP to assist in the development of the National Strategic Computing Reserve (NSCR) by holding a tabletop exercise (TTX). This TTX was meant to explore the NSCR's organization, operation, obstacles to federal agency participation, and actions during a crisis with attendees from across the federal government. On August 21, 2024, STPI held a TTX with three exercises across two crisis scenarios. This report elaborates upon the structure of the TTX, the results of the post-TTX analysis, and the findings and recommendations for next steps guided by research questions used during the TTX.

15. SUBJECT TERMS

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