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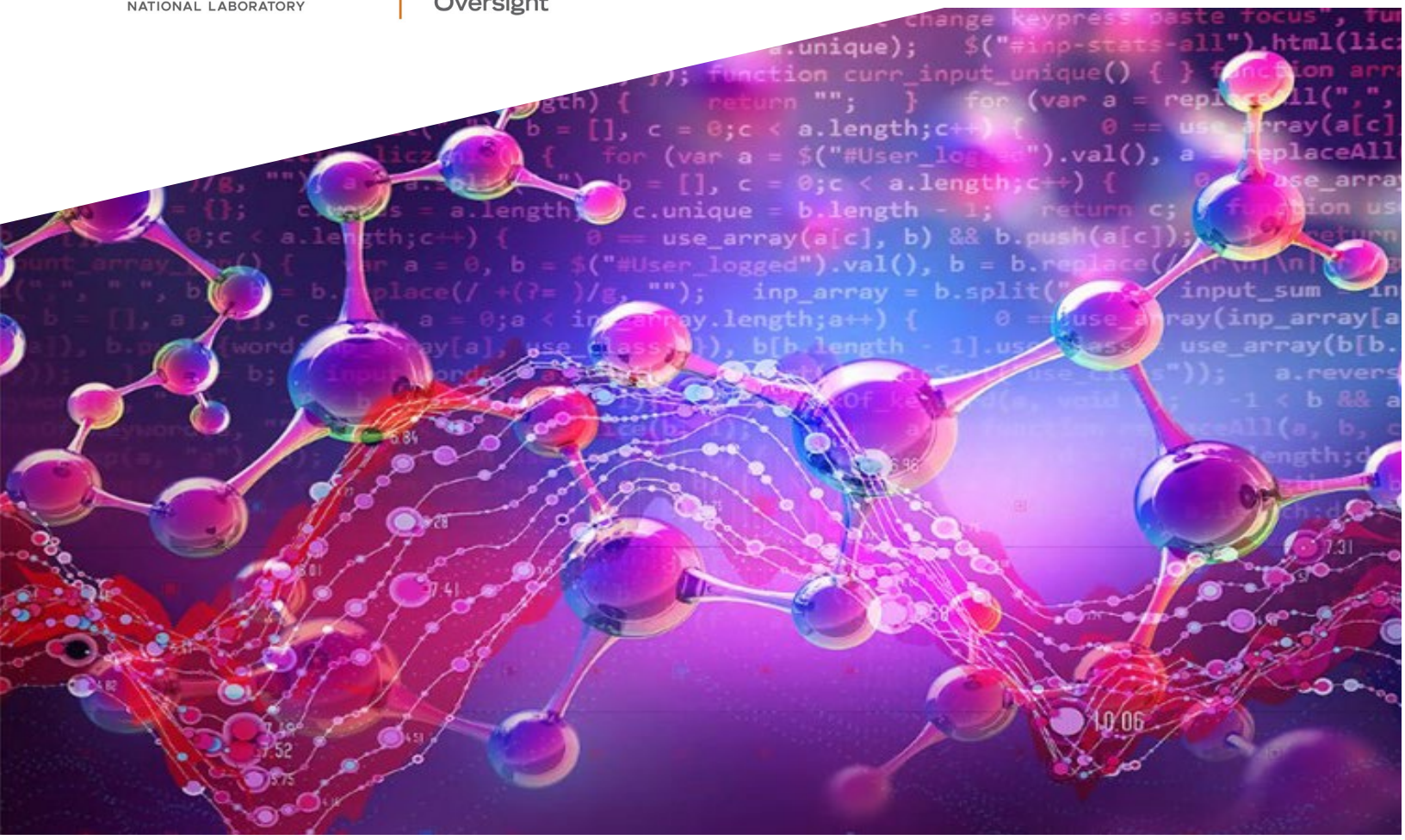

Benchmarking the Lab Fellows Program

(IO-FY20-05; AST 02047)

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Acronyms

ALD	Associate Lab Director
ANL	Argonne National Laboratory
ANS	American Nuclear Society
CSTO	Chief Science and Technology Officer
CTO	Chief Technology Officer
DOE	U.S. Department of Energy
INL	Idaho National Laboratory
IO	Independent Oversight
LANL	Los Alamos National Laboratory
LBNL	Lawrence Berkeley National Laboratory
LDRD	Laboratory Directed Research and Development
NIST	National Institute of Standards and Technology
OFI	Opportunities for Improvement
ORNL	Oak Ridge National Laboratory
PAC	Promotion Advisory Committee
PLI	performance-level indicator
PNNL	Pacific Northwest National Laboratory
S&E	scientist and engineer
S&T	science and technology
SNL	Sandia National Laboratories
Virginia Tech	Virginia Polytechnic Institute and State University
WSU	Washington State University

Executive Summary

PNNL's Fellows are recognized as having attained the institution's highest level of scientific and technical achievement. These individuals are internationally recognized by their peers and have demonstrated innovation and leadership throughout their careers.

PNNL's Independent Oversight (IO) office led an assessment to benchmark how other research and development organizations identify, advance, recognize, and utilize their Fellows. The 12 research organizations interviewed included Argonne National Laboratory, Idaho National Laboratory, Lawrence Berkeley National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Sandia National Laboratories, Boeing Research and Development, Dow Chemical Company, Intel, Microsoft, National Institute of Standards and Technology, and Virginia Polytechnic Institute and State University. The assessment team also interviewed PNNL Fellows and senior-level managers to identify areas of strength and potential areas of improvement.

The assessment team found that PNNL's criteria for becoming a Fellow and the characteristics of the Fellow role are consistent with those at the other U.S. Department of Energy (DOE) national laboratories interviewed. Based on benchmarked industry and academia practices, PNNL's Lab Fellows Program could be improved by aligning the stated desires of PNNL senior management with the aspirations of the Fellows themselves. Observations from interviews are summarized below with Opportunities for Improvement (OFIs) following.

- Fellows are selected for the body of work accomplished. The title of "Fellow" is an honorific one that the Fellow keeps throughout their career.
- All organizations benchmarked look to their Fellows to provide technical leadership. Some Fellows are deeply and singularly focused in their area of research, while others develop breadth of impact across different programs and internally based efforts.
- Coaching and mentoring are universally expressed as a key expectation.
- Fellows (across all organizations) play a significant role in the promotion process for new Fellows, providing recommendations to senior leadership on new candidates.
- The corporate and university benchmarks have well-defined expectations and strategic roles for their Fellows—they use their Fellows to help shape the future of the organization. Fellows are seen as part of the organization's competitive advantage.
- The expectations for Fellows at DOE's national laboratories are communicated through an institutional set of performance-level indicators (PLIs) typically tied to the highest rung of the science and engineer (S&E) career ladder. Contributions for additional service activities (e.g., mentoring) are influenced and reinforced by the line manager.
- Within the national laboratories studied, Fellows report to all levels of the management hierarchy, from a Team Leader to an Associate Lab Director. Fellows reporting to managers at lower levels tend to lack the level of engagement from executives within the company commensurate with their status. With the industry benchmarks, Fellows report to a senior-level manager above their own rank. Reporting to senior leadership comes with more strategic knowledge of the organizational direction, mission needs, and the capabilities of the company.
- All the benchmarked organizations expressed a need to improve the diversity of the pipeline that feeds into their Fellow rank.

Opportunities for Improvement

There first three OFIs represent incremental improvements to PNNL's current Lab Fellows Program. OFI-4 represents an approach to re-architect the existing program (and includes elements of the first three OFIs).

- (OFI-1) Update expectations for Fellows to align PLIs to clearly differentiate from S&E 5s and include expectations for service to the Laboratory. Add clarity of expectations for engagement in strategic roles.
- (OFI-2) Consider elevating the reporting of the Fellows to line managers of higher rank to improve their sphere of influence and provide more opportunities for engaging strategically and mentoring by higher levels of Laboratory leadership.
- (OFI-3) Develop a plan focused on advancing the technical and demographic diversity to becoming a Lab Fellow.
- (OFI-4) Develop, define, and document Lab Fellow expectations to better align with senior management expectations and the aspirations of the Fellows. Clearly define the difference in expectations between the Battelle Fellows and the Lab Fellows. Update the promotion process and reporting/management of the Fellows to achieve and sustain the expectations.

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Introduction

Pacific Northwest National Laboratory's (PNNL or Laboratory) Independent Oversight (IO) office facilitated a benchmarking assessment that compared PNNL's Lab Fellows Program with 12 external research organizations, including

1. Department of Energy (DOE) national laboratories: Argonne National Laboratory (ANL), Idaho National Laboratory (INL), Lawrence Berkeley National Laboratory (LBNL), Los Alamos National Laboratory (LANL), Oak Ridge National Laboratory (ORNL), and Sandia National Laboratories (SNL).
2. Industry organizations: Boeing Research and Development, Dow Chemical Company, Intel, and Microsoft.
3. Other research organizations: National Institute of Standards and Technology (NIST) and Virginia Polytechnic Institute and State University (Virginia Tech).

The objectives of this assessment were to identify and benchmark the

- role of a Fellow
- leadership expectations of Fellows
- process or pathway to becoming a Fellow
- duration of a Fellow appointment and the size of the cadre of Fellows (vis-à-vis the science and engineering population)
- impact of the Fellows on the institution.

The outcome of this assessment is a summary report comparing the practices of Fellows across select DOE national laboratories, industry, academia, and government organizations. Included in this report are four Opportunities for Improvement (OFIs) for consideration by PNNL's Deputy Director for Science and Technology and the Laboratory Leadership Team.

Assessment Participants and Methodology

During the months of August to September 2020, a team of senior-level subject matter experts, with a wide range of expertise, conducted this assessment (see biographies provided in Appendix A).

The assessment team interviewed members of each of the 12 benchmarked organizations using a standard set of lines of inquiry (see Appendix B) tied to the objectives of this assessment. Care was taken to capture a range of perspectives, from government, DOE national laboratories, industry, and academia.

Internally, the team interviewed a sampling of PNNL Fellows from each research directorate, the PNNL Fellows' Promotion Advisory Committee (PAC), Associate Laboratory Directors (ALDs), Chief Science and Technology Officers (CSTOs), Operations Managers, and Division Directors (see Appendix C).

In the following sections of this report, terms are simplified for the purposes of clarity. For example, the "Lab Fellows Program" is used to describe the cadre of Fellows at PNNL and their activities as a group. Organizations have different titles for Fellows. For the purpose of comparison to PNNL, this report describes the roles of the most senior scientists and engineer levels as Fellows. NIST has scientific and professional positions equivalent to the Senior Executive Service without management requirements, and Virginia Tech has University Distinguished Professors. For the purpose of this report, these two categories will be considered Fellows.

Importance of PNNL's Lab Fellows Program

The reputation of PNNL and other Battelle-affiliated laboratories and prospects for future success are directly linked to the excellence and productivity of our S&Es. The category of Fellow rewards the quality and growth of senior-level S&Es and provides the opportunity to inspire early career researchers. Fellows are leaders in many of the scientific areas important to the Department of Energy and other government agency missions.

The importance of the Fellows to the Laboratory is reflected in the rigor PNNL exercises in the selection of new Fellows. PNNL has two categories of Fellow: 1) Battelle Fellow and 2) Lab Fellow. Qualifications for the two categories differs only in the degree of their scientific achievements. Battelle Fellows are recommended by the Laboratory Director, following consultation with current Battelle Fellows, and appointed by the President and Chief Executive Officer of Battelle Memorial Institute. Lab Fellows are nominated by their management team, recommended by their peers on the PAC, and appointed by the Laboratory Director.

> ***"We want to assure that the Fellow title is honorific and purposeful."***
>
> *-PNNL Fellow*

PNNL's Fellows increased their contribution to the Laboratory by establishing a Council of Fellows in 2002 to provide improved coordination and networking for the Fellows across the Laboratory. The Fellows also support mentoring and science and technology (S&T) advances through the Laboratory Directed Research and Development (LDRD) Open Call. These LDRD projects provide early career staff the opportunity to conduct research with mentoring from a Fellow.

This benchmarking assessment is aimed at providing the Deputy Director for Science and Technology and the Laboratory Leadership Team with ideas that could enhance the impact of the Lab Fellows Program at PNNL. To quote a Fellow, "We want to assure that the Fellow title is *honorific and purposeful*."

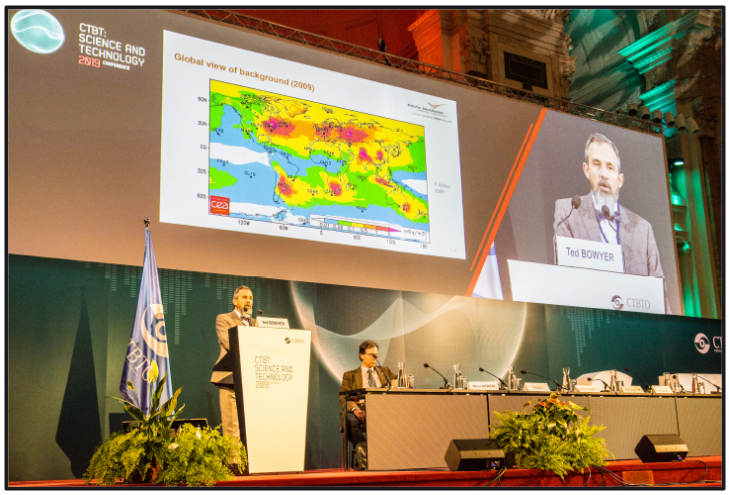

Figure 1. PNNL Lab Fellow Ted Boyer giving a keynote speech at the Comprehensive Test Ban Treaty Office's International Science and Technology Conference in Vienna, Austria in 2019.

Assessment Results

PNNL is similar to the benchmarked organizations in that the title of "Fellow" is an honorific one that typically includes promotion to a career level that recognizes the staff member's advancement in skills and impact. Generally, the honorific title is kept throughout one's career, even when the individual moves into management.

The summary conclusion of this benchmarking assessment is that PNNL's practices for the role, pathway, and pipeline to becoming or being a Fellow is generally consistent with most of the practices of other national laboratories interviewed.

PNNL's program lacks some of the industry and academia practices that allow Fellows to achieve higher levels of influence within the organization. Based on these benchmarked industry and academia practices, there are opportunities to improve PNNL's existing Lab Fellows Program that also align with the stated desires of PNNL senior management and with the aspirations of the Fellows themselves. There is also an opportunity to transform PNNL's Lab Fellows Program into a competitive advantage from the perspective of strategic scientific impact, recruiting, and retention.

Summary-level differences are described in Table **1**, with further elaboration of these points provided in the sections that follow.

Table 1. Comparison between DOE national laboratories and industry Fellows practices.

NATIONAL LABORATORIES Honorific and Retrospective	INDUSTRY Competitive Advantage
• One to two tiers (or categories) of Fellows • Elite group representing a small percentage of the research staff • Rigorous peer-review process for new Fellows • Fellows expected to be strong technical contributors and mentors • Promotion process is honorific • Role and performance expectations are not documented in a prioritized and impactful way • Reporting structures based on a line management model • Strategic engagements, program development engagements, Lab-level impacts are typically ad hoc and based on the individual • The cadre of Fellows may or may not have frequent senior leadership engagement (depending on the national laboratory)	• Multiple tiers (or categories) of Fellows • Elite group representing a small percentage of the research staff; can include vice presidents of an organization • Rigorous peer-review process for new Fellows • Fellows expected to be strong technical contributors and mentors • Promotion process is honorific and linked to growth, proficiency, and future utilization of Fellows at every tier • Corporate performance expectations for Fellows are clearly identified • Reporting structure based on tier and expected sphere of influence • Fellows are expected to shape the future of the organization—identified as creators of opportunity; technical Fellows seen as part of the company's competitive advantage • Strong internal networking activities, especially in global organizations, and engagement in organizational strategy; key feature in recruiting and retention

The Role of a Fellow

At PNNL, the title of Fellow is the highest level of recognition for technical/scientific achievement bestowed by PNNL. The Fellow designation is associated with a career-ladder promotion that recognizes the staff member's advancement in skills and impact throughout their career.

Among the benchmarked DOE national laboratories, industry, NIST, and Virginia Tech, there was strong agreement on the following roles for the Fellows:

- *S&T Leadership.* All organizations expect S&T leadership from their Fellows. Some Fellows are singularly and deeply focused in their research area; others develop breadth of impact by applying their technical acumen across different programs. Industry and Virginia Tech expect Fellows to broaden and expand their roles as part of their career growth and subsequent promotion to higher tiers within the Fellow ranks.
- *Coaching and Mentoring.* Coaching and mentoring is universally expressed as a key expectation and strongly encouraged. Of particular note is mentoring that has been formalized by the Fellows at PNNL and SNL through their respective LDRD programs.
- *Community of Fellows Activities.* Among the DOE national laboratories, PNNL's cadre of Fellows stand out for their group activities. This includes the PAC and a formal Council of Fellows that runs a seminar series and manages the LDRD Open Call. There are some similar practices at the other DOE national laboratories, most notably leading the promotion committee for new Fellows.
- *Joint Appointments with Academia.* At DOE national laboratories, NIST, and Virginia Tech, joint appointments represent a tool for maintaining S&T leadership (joint appointments are not implemented by all the DOE national laboratories). The practice is not constrained to the Fellows; it can apply to any senior-level scientist or engineer with management approval.

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Among the DOE national laboratories, PNNL's Council of Fellows stand out for their coordinated set of group activities.

Leadership Expectations

The clearest differences noted in this assessment involve leadership expectations for Fellows and how these expectations are documented, communicated, and implemented.[1]

Among the DOE national laboratories benchmarked, all S&Es have a set of performance-level indicators (PLIs) for their rank. Fellows are typically associated with the highest career-ladder level.[2] In addition to the PLIs, mostly all the DOE national laboratories also expect service to the Laboratory (e.g., being on a search committee or mentoring). Expectations for service may not be included in the PLIs and are expressed and reinforced by the Fellow's immediate line manager. The disconnect between the alignment of the PLIs and how PNNL Fellows are routinely engaged in the research directorates generates the first opportunity for improvement (OFI-1). During interviews, both PNNL management and Lab Fellows indicated their desire for Fellows to have stronger influence within the organization. The PLIs afford a good starting point but should be more clearly differentiated from the lower-level S&E PLIs and include expectations for service. This will enhance the clarity of Fellow expectations and help line management provide direction. In addition, opportunities for engagement in strategic roles should be considered, documented, and communicated.

Most of the DOE national laboratories engage their Fellows in important, yet tactical functions with the level of activity often influenced by management

[1] At PNNL, expectations are documented as PLIs and are noted in Appendix D for comparison between S&E 5s and S&E 6s (Fellows).
[2] On LANL's S&E ladder, Fellows can range from a Level 4 to a Level 6.

expectations and available overhead funding.[1] This is in stark contrast to Fellows in industry and at Virginia Tech, where senior leadership expectations are more clearly identified.

The most profound differences in the role of a Fellow at a DOE national laboratory versus industry is associated with participation in strategy development and execution, such as developing technology roadmaps with the Chief Technology Officer (CTO), teaming with other senior leaders to identify new areas of opportunity, and demonstrating technology leadership in meetings with customers, partners, and key stakeholders. For example, within NIST, Fellows are called upon to advise the NIST Director on promising technical directions to anticipate the needs of industry, technology, or science. These practices are enabled by Fellows reporting to higher levels within the organization, having routine access to executives in the organization, and frequent networking opportunities with other Fellows within the organization.

Other observations relative to leadership expectations include the following:

- Senior-level Fellows in industry, Virginia Tech, and NIST are considered "ambassadors" in that they are expected to routinely represent the institution to distinguished visitors, customers,
- and stakeholders as a part of their position. What marks this as different than what was described by most of the DOE national laboratories studied (and where it is assumed that Fellows also advocate for their institution)

  is that demonstrated communication skills of the Fellow nominee are factored into the decision to elevate the staff member to the Fellow position, with clearly defined expectations associated with the role.
- There were discussions with interviewees regarding maintaining the title of Fellow when performance issues arise. In the rare instance where a performance issue is serious and impacts the institution's reputation, the title has been removed. However, it is more common to have some years more productive than others while the title is retained. These swings in performance are handled through the normal annual staff development review channels and rarely result in removal of the title of Fellow.
- No organization in this benchmark assessment reported collecting metrics of S&T impact, networking, or engagement trends on their cadre of Fellows.

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Virginia Tech describes its Distinguished University Professors as "ambassadors" in the sense that they are expected to represent the institution internally and externally to highly distinguished visitors.

Table 2. Expectations of Fellows between DOE national laboratories and industry.

NATIONAL LABORATORIES Expectations Set By Line Management	INDUSTRY Well-Defined Institutional Expectations
• Strong emphasis on S&T leadership and mentoring • Expectations are communicated by the immediate supervisor, which can vary from the Team Lead to the Laboratory Director • Expectations documented in the career ladder description • Strategic engagements are typically based on the individual (not as a result of being a Fellow) • Expectations for contributing strategically at the Lab-level varied by national lab (some Fellows have only limited roles, while others play significant roles in Lab-level strategies)	• Strong emphasis on continued S&T leadership and the development of corporate or business line strategies • Expectations communicated from upper-level line managers to corporate executives; reporting levels established to give appropriate sphere of influence and strategic outlook • Corporate expectations for performance are clearly identified and documented for each tier of Fellow • Fellows are identified as creators of opportunity as opposed to reviewers of existing programs (although they do both) • Strong internal networking activities among other Fellows and executives, especially in global organizations

[1] Funding is almost always granted for service activities.

Nominating and Selecting Fellows

The organizations that participated in this assessment had comparable review processes for nominating and selecting new Fellows. Typically, senior line management nominate staff (sometimes with the help of Fellows) and prepare a detailed promotion package, including internal letters of support with international and national external references. The intent of the nomination is to show that the staff member has reached the highest level of scientific or engineering performance and impact in the organization.

The package is reviewed by a committee that includes existing Fellows and can also include management and Human Resources. The committee provides a recommendation to an executive (e.g., the Lab Director at a DOE national laboratory) for final selection and approval. On occasion, non-Fellow staff or managers may be brought into the process to identify technical skill gaps in the Fellow community and to mitigate any bias in the peer review process.

Observations regarding nomination and selection of Fellows include the following:

- One area of agreement across benchmarked organizations includes the duration for Fellows. The title lasts throughout the career of the staff member, including when the Fellow accepts a position in management.[1] Often, there are emeritus Fellows that remain active at the institution after retirement.
- Within the DOE national laboratories interviewed, the title of Fellow can be bestowed after the staff member has been elevated to the requisite career ladder level for a period of time (e.g., with strategic new hires). The latter represents a hybrid system where there are staff in the highest S&T career ladder with some as Fellows and others not.

Most other organizations benchmarked do not bring external hires into the role of Fellow until they have demonstrated a fit within the DOE national laboratory, company, or university. PNNL's process allows external hires to be brought in as a Fellow, usually after an accompanying review by the PAC and approval by the Battelle Chief Executive Officer (for Battelle Fellows) or the Laboratory Director (for Lab Fellows).

Nomination Criteria

Typical criteria for nominating staff includes scientific or engineering reputation, innovation, mission impact, leadership (both internally and externally), program contributions (or financial contributions in industry), and recognition (e.g., awards, publications, technical conferences).

In industry, there are additional criteria including how well the nominee:

- Influences technical business decisions independent of organization or authority
- Works across organizational lines and adds value in their technical area of expertise
- Makes technical decisions with the company strategy in mind (as opposed to the individual's group focus)
- Contributes to building the future technical community through teaching, mentoring, advising, and leading
- Contributes to a "one culture" in the company
- Demonstrates leadership principles, cultural attributes, and values.

[1] At Virginia Tech, one tier of Fellows—the Alumni Distinguished Professorships—has a term that is renewed every 10 years.

Reporting Structure Affects the Sphere of Influence of a Fellow

Within the DOE national laboratories studied, there is no single reporting structure for Fellows. Reporting can span from a Team Leader who is a supervisor in PNNL's line management model (typically one or more S&E levels below a Fellow) to an ALD who is a Level 1 executive within the organization. At PNNL, there are Fellows that are Team Leads, and in some instances, Fellows are in managerial ranks and/or report to an ALD.

SNL's structure is an exception. One tier of Fellows report to Center Directors (the equivalent of a Level 2 Division Director at PNNL), and the highest level Fellow tier reports to ALDs.

In the industrial benchmarks, due to the Fellow ranks having an organizational level equivalency with managerial positions, the Fellows typically report to a manager who is one level above the Fellow's equivalent level. The more senior tier of Fellows report to corporate vice presidents and frequently have a network connection with the CTO (or equivalent). Increasing seniority of management levels come with a broader and more strategic knowledge of the organizational direction, mission needs, and the capabilities of the organization. Fellows reporting to higher levels connect to and are involved with strategic direction resulting in greater impact within their organization. As such, they are closer to the decision-makers that propel the organization in forward-leaning directions.

Fellows reporting to managers at lower levels in an organization can (and do) provide assistance to supervisors in mentoring staff, but the Fellows themselves do not get the engagement, coaching, and mentoring commensurate with their status from executives and Level 2 managers (i.e., Division Directors). This executive-level engagement and coaching are key elements in retaining Fellows, enabling them to continue their career growth, and represents a significant competitive advantage that industry takes advantage of.

The lack of alignment between the expressed expectations for Fellows and the reporting structure realities constitutes an opportunity for improvement (OFI-2).

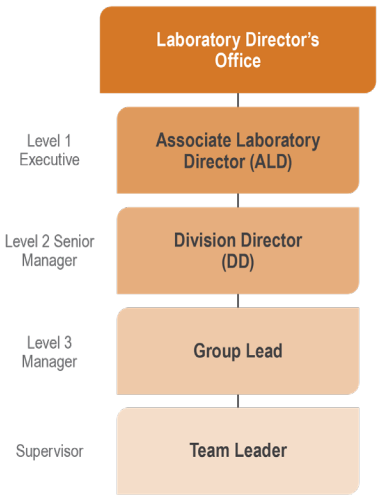

Figure 2. Line management model and hierarchy of roles within PNNL's research organizations.

Pipeline Needs More Intentional Development

For most organizations, the R&D pipeline represents the sole source of future product development and potential innovation.[1] It is important to develop the pipeline of scientists and engineers that aspire to become a Fellow in an organization. Most of the benchmarked organizations expressed a need to improve their organization's pipeline in this regard.

Engaging scientists and engineers at levels below a Fellow is important to building a strong pipeline of potential future candidates. When stewarded and actively managed, strong pipeline development leads to greater staff retention, provides the opportunity to address alternate career paths for staff, and minimizes potential career workarounds for staff in technical disciplines that have historically had difficulty in achieving Fellow status.

Most benchmarked organizations use various approaches to prepare S&Es at lower levels to become Fellows. Some approaches to pipeline development include

- Establishing internal academies for future Fellows
- Early mentoring of high-potential staff (two to three levels below the Fellows) to think strategically about career trajectory options
- Engaging early career staff often and proactively network with Fellows across the organization
- Using data-driven information to inform management of talent that may not be obvious.

With regard to using data-driven information, Virginia Tech uses an academic analytical firm to review the productivity of their professors for potential promotion. This was highlighted as a best practice to help inform hidden talent within an organization. It is also used to help inform their Fellows selection.

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Virginia Tech uses data mining activity to mitigate the unintended consequences of a pure advocacy-based system.

Diversity and Inclusion

Most pipeline systems rely on diversity and inclusion programs in their approach to enhance the overall diversity in the pipeline. Diversity brings in new ideas, experiences, and the ability for people to learn from one another. This leads to better problem-solving, increases and opens up dialogue, and promotes creativity and innovation. All the organizations benchmarked acknowledged the need to increase diversity among their ranks of scientists and engineers (including their Fellow ranks). Below are highlights the assessment team gleaned from these discussions:

- It was noted by interviewees that there is shrinking diversity the higher you go in the ranks. The axes of diversity needs to be more actively cultivated (e.g., gender, ethnicity, technical discipline).
- While progress on demographic diversity has been slow, research organizations indicated progress with lower-level S&Es within their organizations. This should eventually improve the diversity of the Fellow cadre over time.
- Most organizations have started to adjust their criteria to improve their technical diversity. Examples include the development of different criteria for different disciplines and through expanding the traditional metrics for nominees. This also includes adjusting the criteria for scientists versus engineers.

The assessment team believes that the technical and demographic diversity of the Fellows cadre needs to be improved to advance the pipeline for becoming a Lab fellow and the overall pipeline of scientists and engineers (OFI-3).

[1] Kopytko, Roman. "4 Aspects of Managing an R&D Pipeline." Wellspring Blog. January 3, 2019. https://www.wellspring.com/blog/4-aspects-of-managing-an-rd-pipeline

Funding for Fellows

When it comes to funding a Fellow for their time, there is variability across the organizations benchmarked. In most cases, Fellows are direct funded through their research work paid for by a sponsor or client. Service to the organization is not necessarily expected to be paid for out of overhead. There are instances where Fellows are asked to participate in institutional or organizational activities, and overhead funding is usually provided by their management. Examples of where funding or other benefits are provided to Fellows are described below.

- At ANL, 10 percent funding is provided to the Chair of the Fellows to organize Fellow-related activities.
- At INL, $50K total is available to support the Fellows for service activities (there are a total of five). This funding is allocated by the Chair of INL's Lab Fellows, as needed.
- At LANL, there is a one-time honorarium associated with being named a Lab Fellow.
- At PNNL, a limited amount of overhead funding is available to Fellows for special projects requested by management. This is allocated on a case-by-case basis.
- At SNL, the highest tier of Fellows (total number is seven) are funded at approximately 10 percent of their time to cover institutional activities, with LDRD being the single most important funding source.[1]
- At Virginia Tech, a small amount of operating funds are available ($10K each) to University Distinguished Professors (highest tier of Fellows of which there are a total of 16) for creative and professional development time.
- At NIST, Fellows have increased annual leave carryover (720 hours vs. 240 hours). NIST Fellows also are granted a postdoctoral researcher to work with them on important new research areas of their choice.
- At Boeing, each of the major divisions handles funding for Fellows differently. The research and development organization, which has the most Fellows, does not cover service time. The Commercial Airplane Division and Defense Systems provide at least partial support to their Fellows.

[1] There are approximately seven Lab Fellows at SNL (highest tier of Fellows)

Architecture of PNNL's Lab Fellows Program

In previous sections of this report, the assessment team summarized observations and suggested incremental opportunities for improving PNNL's existing practices as they relate to the Fellows Program. In this section of the report, the assessment team collated ideas in one place to provide an example for how re-architecting PNNL's Lab Fellows Program could lead to greater impact for the Laboratory (OFI-4). To achieve a more purposeful program, the assessment team identified a fourth OFI that encompasses the following recommendations:

- Develop a set of key principles for what it means to achieve the rank of Fellow at PNNL.
- Update expectations for Fellows
  - Develop expectations that differentiate a Battelle Fellow from a Lab Fellow.[1]
  - Update and align PLIs to clearly differentiate from S&E 5s.
  - Clarify expectations for service to the Laboratory and for engagement in strategic roles. Consider elevating who the Lab Fellows report to in an effort to improve their sphere of influence and provide more opportunities for engaging strategically and mentoring by higher levels of Laboratory leadership.
  - Develop the role of a Fellow as an ambassador for PNNL and incorporate this into each Fellow's performance expectations.
- Develop a plan to advance the technical and demographic diversity of the Lab Fellows by focusing on the technical and demographic composition of the staff ranks from which Lab Fellows are promoted.
- Broaden the networking opportunities with ALDs, CSTOs, and Fellows themselves to enable and inform the Lab's strategies.
- Develop communications that excite the technical staff, provide managers with a deeper understanding of the Fellows' roles so they can mentor and support pipeline development, and enhance the strategic engagement by Laboratory Leadership, CSTOs, and sector leaders.

[1] The expectations for Lab Fellows should also clearly differentiate expectations from the S&E 5 level.

Ideas for Improving a Fellows Program

Through the course of this assessment, external organizations and internal PNNL staff shared ideas for improving practices. Some ideas have been implemented, with other ideas planned. The ideas below are from the benchmarked organizations, with PNNL's managers' and Fellows' ideas for improving the PNNL's Lab Fellow program following.

Ideas from Benchmarked Organizations to improve their processes include the following:

- Facilitate an internal, virtual academy for scientists and engineers to drive scientific connectivity and networking. Suggested activities include sharing leadership experiences, championing proposals, advocating for career development of early career scientists and engineers, as examples. (Dow Chemical)
- Hold a biannual summit with Fellows for a day to network, discuss critical issues of importance, and welcome new Fellows. (Microsoft)
- Consider hosting an annual meeting where Fellows get together to network and learn from one another. (Boeing)
- Bring the Fellows together for the purposes of collaboration and networking. (Intel)
- Form a committee of Fellows to promote award nominations. (ANL)
- Engage an analytics firm to help quantify scholarly contributions *across disciplines* as a part of the nomination process for new Fellows. (Virginia Tech)
- Create an official Fellows Council that more fully engages the DDST and the Lab Director. (SNL)
- Use a Fellow forum to help guide early career scientists and engineers with their career development. (ANL)

> ***"The potential of a Fellow is to lead by example, strive for excellence, mentor and help others, and enhance cross-disciplinary collaborations."***
>
> *-PNNL Fellow*

- Provide discretionary time for Fellows to think about bigger picture and long-term issues. (INL)
- Find ways to increase diversity. (LANL, ORNL, NIST)

PNNL internal input to the Lab Fellows Program included the following:

- Celebrate the accomplishments of PNNL's Fellows often and increase recognition Lab-wide.
- Consider how Fellows could take on managerial rotational assignments that build their experience and expose them to strategic opportunities.
- Create a training module on the Lab Fellow rank for PNNL's new hire orientation and onboarding for S&Es and for the Science and Engineer Development Program.
- Refine Fellow PLIs to include existing promotion criteria. Consider raising the bar.
- Consider separating the S&E Level 6 career ladder from the title of Fellow (so some staff can be a Level 6 without being a Lab Fellow).
- Consider expanding the role of Fellows to include nominations for new Fellows. Update the Lab Fellows charter to reflect the change.

Opportunities for Improvement

Based on the summary observations, four OFIs are recommended. Note, OFI-1 through OFI-3 represent improvements to PNNL's existing program. OFI-4 represents an approach to re-architect the existing program, which includes elements of the first three OFIs.

- (OFI-1) Enhancing the clarity of Fellow expectations will help line management provide direction and differentiate expectations from lower-level S&E PLIs. **Update expectations for Fellow PLIs to clearly differentiate from S&E 5s and include expectations for service to the Laboratory**. **Clarity of expectations for engagement in strategic roles should be considered, documented, and communicated.**

  Management Response:

- (OFI-2) The reporting structure of a Fellow affects the sphere of influence inside the Laboratory. **Consider elevating the reporting of the Fellows to higher ranking line managers to improve their sphere of influence and provide more opportunities for engaging strategically and mentoring by higher levels of Laboratory leadership.**

  Management Response:

- (OFI-3) The technical and demographic diversity of the Fellows cadre needs to be improved to advance the pipeline for becoming a Lab fellow and the overall pipeline of scientists and engineers. **Develop a plan focused on advancing the technical and demographic diversity for becoming a Lab Fellow.**

  Management Response:

- (OFI-4) The cadre of Fellows can become a strategic, competitive asset**. Consider re-architecting the Fellows Program by developing, defining, and documenting Fellow principles and expectations to better align with senior management expectations and the aspirations of the Fellows. Clearly define the difference in expectations between the Battelle Fellows and the Lab Fellows. Update the promotion process and reporting/management of the Fellows to achieve and sustain the expectations.**

  Management Response:

Appendix A. Assessment Team Biosketches

Chris Deeney, Ph.D. (PNNL), Assessment Lead

Christopher Deeney is responsible for identifying relevant and compelling national security S&T challenges and developing a cohesive strategy to establish and differentiate national security S&T capabilities and leadership. Dr. Deeney joined PNNL in August 2018 from a period of consulting on national security. Previously, he was on a special assignment for the parent organization of National Security Technologies (NSTec). He has also served as Vice President for Program Integration and CTO at NSTec, where he was responsible for three directorates with 1,000 staff in stockpile stewardship, global security, and environmental management, with an annual combined budget of $500M. The Nevada National Security Site is a 1,360-square-mile site with multiple nuclear and high hazard facilities. As CTO, he oversaw strategy development for internal S&T programs and technical partnerships. Prior to NSTec, Dr. Deeney held multiple leadership positions at the National Nuclear Security Administration from 2006 to 2013. He was the Assistant Deputy Administrator for Stockpile Stewardship, managing the $1.7B stockpile stewardship program at three national laboratories and the Nevada National Security Site. Due to the program oversight of research and development in multiple nuclear and high hazard facilities, he qualified as a Senior Technical Safety Manager. He led the completion of the National Ignition Facility (NIF) as Director of Inertial Confinement Fusion and NIF in 2009. He also managed science, technology, and engineering for stockpile stewardship as the Director of the Office of Defense Science. Dr. Deeney has also served as a senior manager and principal technical staff member in pulse power technologies, shock physics, and Z-pinch physics at Sandia National Laboratories from 1995 to 2006. He was responsible for numerous experiments with direct impact on nuclear weapon physics and non-nuclear components in all aspects of the stockpile to target sequence. Dr. Deeney is a Fellow in the American Physical Society and the Institute of Electrical and Electronics Engineering. He earned a Ph.D. in Plasma Physics from Imperial College, UK.

Michelle Buchanan, Ph.D. (ORNL)

As Deputy for Science and Technology, Dr. Buchanan oversees one of the nation's most extensive portfolios of research and development, spanning physical and materials sciences, energy and engineering sciences, computing and computational sciences, biological and environmental sciences, neutron sciences, and global security, for the U.S. Department of Energy and other sponsors. Before assuming her current position in October 2017, Dr. Buchanan was the Associate Laboratory Director for Physical Sciences for more than a decade. She served as director of the ORNL Chemical Sciences Division from October 2000 to November 2004 and as associate director of the ORNL Life Sciences Division from January 1999 to September 2000. She initiated the Center for Structural Molecular Biology at ORNL, serving as its director from 1999 to 2003, and led the Organic and Biological Mass Spectrometry Group in the Chemical and Analytical Sciences Division (now the Chemical Sciences Division) from 1986 to 1999. She joined ORNL after earning a B.S. in chemistry from the University of Kansas in Lawrence, Kansas, and a Ph.D. in chemistry from the University of Wisconsin in Madison, Wisconsin. She is a Fellow of both the American Association for the Advancement of Science and the American Chemical Society. Following the conclusion of this assessment, Dr. Buchanan joined DOE as Senior Technical Advisory, Office of the Deputy Director for Science Programs in the Office of Science.

Sue Clark, Ph.D. (PNNL)

Sue B. Clark is the Chief Science and Technology Officer and a Battelle Fellow in the Energy and Environment Directorate at Pacific Northwest National Laboratory. She is jointly appointed at PNNL and at Washington State University (WSU), where she is a Regents Distinguished Professor of Chemistry. In this joint appointment, she leads a research effort focused on the chemistry and chemical engineering of processing nuclear materials. Dr. Clark is an internationally renowned environmental radiochemist who has published more than 120 peer-reviewed papers focused on actinides in the environment, chemistry of high-level radioactive waste systems, and radioanalytical chemistry. At WSU, she developed the radiochemistry program in the Chemistry Department. She joined PNNL in January 2015 to lead multiple nuclear science initiatives. Since becoming CSTO in September 2017, she also is responsible for stewarding institutional investments in energy and environment research and development. She

holds a B.S. degree in Chemistry from Lander College (Greenwood, SC) and M.S. and Ph.D. degrees in Chemistry from Florida State University (Tallahassee, FL).

Pamela Hughes (PNNL)

Pam Hughes manages PNNL's IO Office and is responsible for the planning and management of IO assessments to determine the efficiency, effectiveness, and adequacy of PNNL's systems, operations, programs, and processes. Pam previously managed the Laboratory's planning function, where new capabilities associated with scenario planning and multiyear planning were developed and implemented. Prior experience includes leading PNNL's Institutional Science and Technology performance under the Office of the Deputy Director for Science and Technology, where new standards for Laboratory-level performance were developed and deployed. She managed PNNL's LDRD Program and instituted PNNL's S&T investment process for major capability development initiatives. She developed and implemented technical review processes; trained with Conger and Elsea, Inc., on causal analysis; and has been involved in operational assessments. She has authored and co-authored a number of internal publications and several white papers on peer review for DOE, as well as on science and technology performance. Her undergraduate degree is in biology and social sciences from WSU, and she completed two years of graduate course work in neurophysiology.

Julia Phillips, Ph.D. (SNL, Retired)

Julia Phillips retired from Sandia National Laboratories in 2015, serving in various positions, including vice president and CTO. Her responsibilities as CTO included leadership of Sandia's LDRD program, research strategy development and implementation, and intellectual property protection and deployment. As director of the nuclear weapons science and technology programs, she was responsible for programs in high-performance computing, engineering sciences, high energy density physics, and dynamic materials and for sustainment of Sandia's mission-critical facilities. Prior to that, she served as director of the Physical, Chemical, and Nano Sciences Center, which performs fundamental research and technology development in nanoscience and nanotechnology, compound semiconductors, radiation effects, and remote sensing. Areas of particular emphasis that emerged during her tenure include the science and technology of solid-state lighting, nanoscience (including the DOE Center for Integrated Nanotechnologies), and quantum computing. In 2005 to 2007, she served concurrently as director of the Center for Integrated Nanotechnologies, a DOE Office of Basic Energy Sciences nanoscale science research center at Sandia and Los Alamos National Laboratories. Dr. Phillips joined Sandia as manager of a materials science organization in 1995 after spending 14 years at AT&T Bell Laboratories as a staff member and technical manager. Her research was in the areas of epitaxial metallic and insulating films on semiconductors, high-temperature superconducting, ferroelectric, and magnetic oxide thin films, and novel transparent conducing materials. Dr. Phillips is a member of the National Science Board and the NSB Executive Committee.

Melissa Robinson (LANL)

Melissa Robinson is a management and operations professional who has worked at LANL for 36 years in a variety of management, operations, and business positions supporting science programs. Melissa is currently the Leader of the Science Resource Office, which includes a variety of functions, such as STE peer review and metrics, conference and foreign travel oversight and management, and institutional prize coordination. She is the Research Integrity Officer for LANL. Some of her most impactful accomplishments at LANL include being a founding member of the Los Employees Scholarship Fund, setting up a conference management approval process for LANL, and leading the design and implementation of the LANL Collaboration Space. Melissa received a Masters of Organizational Management degree from the University of Phoenix, an MBA from the University of New Mexico, and a Project Management Professional certification from the Project Management Institute.

Terry Todd, Ph.D. (INL)

Terry Todd has nearly 40 years of experience in chemical separation technology development and implementation for spent nuclear fuel recycle and radioactive waste management. He has worked at Idaho National Laboratory for the past 38 years, with a primary focus on directing research and development of advanced technologies for spent nuclear fuel recycle and other chemical separation applications. He is a Laboratory Fellow at INL (since 2008) and the inaugural and current Director of the Glenn T. Seaborg Institute at INL, which was formed in 2017. He also serves as the National Technical Director for the DOE Nuclear Technology Research and Development Material Recovery and Waste Form Development Program. Terry was the director of the Fuel Cycle Science and Technology Division at INL from 2008 until 2019. He has published over 225 journal articles, reports, and conference proceedings and has been awarded 23 U.S. patents and 6 Russian patents. He has received several national awards including the Glenn T. Seaborg Actinide Separations Award (2005), R&D 100 Award (2006), AIChE (American Institute of Chemical Engineers) Nuclear Engineering Division Robert E. Wilson Award (2011), and the Secretary of Energy's Achievement Award (2013). He serves on the Editorial Board for the journal *Solvent Extraction and Ion Exchange*. Dr. Todd is a Fellow of AIChE and the American Nuclear Society (ANS). He is the past Chair of ANS Fuel Cycle and Waste Management Division, and a lifetime member of the Idaho Section of ANS. Terry holds B.S. and M.S. degrees in chemical engineering from Montana State University and a Ph.D. in chemical engineering from Khlopin Radium Institute in St. Petersburg, Russia. Prior to joining INL, he worked briefly at Battelle Northwest Laboratories from 1980 to 1981.

Appendix B. Lines of Inquiry

The Lines of Inquiry were organized according to the IO assessment's objectives, and included the following:

- Describe your organization's Distinguished Fellows (or equivalent) program. How have the Fellows evolved? Are there tiers (e.g., corporate fellows and Lab fellows)? Who manages/leads the program?
- Describe whether your Fellows are honorific and/or whether this is a position classification.
- Describe whether a Fellow can also be a joint appointment with another organization (e.g., university or Lab).
- Describe the expectations for Lab Fellows (e.g. science and technology leadership, mentoring, reputation building and sponsor impact, driving scholarly output) and the program overall (if there is a program).
- Describe how expectations are communicated and outcomes measured.
- Describe the process by which a Lab Fellow is selected at your institution. How does diversity factor into the process?
- Describe the duration for a Lab Fellow—e.g., are they elected for the lifetime of their career?)
- Describe whether there is limited size to the number of Fellows at your institution.
- Describe the financial model for a Fellow.
- Describe whether Lab Fellows (as a group or individually) have a discretionary set of funds set aside for their use (e.g., LDRD) to do innovative research.
- Describe whether the collective Fellows chair or participate on internal committees.
- Describe whether your organization hires external candidates directly into a Fellow position.
- Describe how you would improve your own program.

Appendix C. Interviewees

External Benchmark Organizations

Argonne National Laboratory (ANL)
- Dr. Charles (Chick) Macal, Argonne Distinguished Fellow

Boeing Research and Technology
- Dr. Anne Kao, Senior Technology Fellow

The Dow Chemical Company
- Dr. David Devore, Corporate Fellow
- Dr. Andre Argenton, Vice President of Research and Development
- Dr. Joel McDonald, Research and Development Strategy Leader

Idaho National Laboratory (INL)
- Dr. Terry Todd, Lab Fellow and Director for Glenn T. Seaborg Institute

Intel
- Carol Huckaby, Program Manager

Lawrence Berkeley National Laboratory (LBNL)
- Bill Johansen, Senior Advisor to the Deputy Laboratory Director for Research

Los Alamos National Laboratory (LANL)
- Dr. John Sarrao, Deputy Director for Science and Technology
- Melissa Robinson, Science Resources Office Manager

Microsoft Research and Development
- Patti, Skoda, Human Resources Leader
- Alex Blanton, Senior Program Manager

National Institute for Standards and Technology (NIST)
- Desiree (Didi) Hanlein, Executive Resources Program Manager

Oak Ridge National Laboratory (ORNL)
- Dr. Michelle Buchanan, Deputy Director for Science and Technology

Pacific Northwest National Laboratory (PNNL)
- Dr. Bob Wright, Lab Fellow and Chair of PNNL Council of Fellows

Sandia National Laboratories
- Dr. Susan Seestrom, Deputy Director for Science and Technology

Virginia Tech
- Dr. Jack Finney, Vice Provost for Faculty Affairs

Internal (PNNL) Benchmark Organizations

Steve Ashby, **Laboratory Director**

Associate Laboratory Directors (ALDs)
- Deb Gracio, National Security
- Lou Terminello, Physical and Computational Sciences
- Jud Virden, Energy and Environment
- Malin Young, Earth and Biological Sciences

Chief Science and Technology Officers (CSTOs)
- Karl Mueller, Physical and Computational Sciences
- Charlette Geffen, Earth and Biological Sciences

Chief Operations Officers (COO)
- Larry Casazza

Division Directors (DDs)
- Jerry Cochran, NSD
- Andrew Cowell, CIT
- Keith Freier, NSD
- Genevra Harker-Klimes, EED
- Kathleen Judd, EED
- Ian Kraucunas, EBSD
- Douglas Mans, EMSL
- Bill Pike, NSD
- Robert Rallo, PCSD
- Bob Runkle, NSD
- Dawn Wellman, EED
- Wendy Shaw, PCSD

Other
- Jim Ang
- Erin Barker
- Ron Melton

Laboratory Fellows
- Nathan Baker
- Ted Bowyer
- Morris Bullock
- Zdenek Dohnalek
- Greg Eiden
- Jerome Fast
- Judah Friese
- Larry Greenwood
- Bruce Kay
- Janet Jansson
- Ruby Leung
- Harry Miley
- Chris Mundy
- Lilijana Pasa-Tolic
- Phil Rasch
- Tim Scheibe
- Greg Schenter
- Eric Smith
- John Vienna
- John Wacker
- Karen Wahl
- Bob Wright
- Sotiris Xantheas

Appendix D. Comparative Performance-Level Indicators Between S&E 5s and 6s

Technical Leadership

- S&E6 – Recognized internationally as an authority by developing and advancing state of the art concepts. Setting the national and international agenda for resolving major challenges.
- S&E5 – Established nationally as an expert in at least one S&E domain. Establishing new approaches at a national level and advancing state of the art concepts.

Organizational Leadership

- S&E6 – Established international networks. Key leader defining Laboratory and sponsor strategic initiatives to expand national and international capabilities for transformational solutions to complex scientific and technical challenges. Sought out to lead cross-directorate/institution teams that influence Lab-wide operations and strategies.
- S&E5 – Established network across PNNL, other national laboratories, academia, industry, and professional societies. Collaborating with other labs, academia, industry and leads multi-lab projects. Leader in the development and execution of directorate strategies. Sought out to lead Laboratory teams that influence operations and strategies. Mentoring mid- to senior staff across PNNL and collaborators.

Project Execution

- S&E6 – Conceives, plans, and realizes lab level R&D strategies and objectives. Demonstrates a high degree of scientific and technical creativity, foresight, and judgment in planning, organizing, and guiding complex national and international programs. Defines and builds new business areas across directorates and institutions supporting self and multiple project teams across internal and external organizations.
- S&E5 – Conceives, plans, and executes R&D with considerable influence on scientific and technological developments. Displays considerable leadership in defining scientific and technical objectives across programs. Leads in the capture, planning, and technical execution of complex interdisciplinary projects and programs across organizational boundaries with lab level impact, and outside of the laboratory. Captures and enables sufficient funding to support self and project teams. Serves as a role model for quality, safety, and security. Contributes to directorate level or lab level operational improvement activities.

Impact

- S&E6 – Sought out to organize and chair sessions at national and/or international meetings. Displays a significant sustained record of technical products influencing their technical discipline. Influences national professional policies and standards. Sought out by Lab leadership, policy advisors, and/or sponsors to set national program direction with impact at a Lab mission level.
- S&E5 – Sought out to participate in peer reviews, and book chapters establishing the foundational aspect of the discipline. Sought out as an invited speaker at national forums. Displays a significant record of technical products influencing their discipline. Recognized by Lab leadership, sponsors, and collaborators as a resource for resolving challenges with impact at a significant programmatic or Lab missions.

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