

Fusion Simulation Program (FSP) Progress Overview and Management Plans

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FSP Program Advisory Committee Meeting

Princeton, NJ

September 23-24, 2010

FUSION SIMULATION PROGRAM (FSP) PROGRESS OVERVIEW & MANAGEMENT PLANS

Outline:

I. Progress Overview on FSP Planning Milestones and Deliverables

II. Current FSP Plans for Management and Governance

III. Responses to Recommendations from FSP PAC (from March, 2010 meeting)

Charge to the FSP PAC – September 23-24, 2010

[Relevant Aspects addressed in all presentations to follow]

- (1) FSP Science Goals -- Regarding the current set of science drivers and associated IPT science development road-maps, please comment on:
 - (a) the current vision for the associated code capabilities that can be expected in nearer-term (within 5 years) and longer term time frames (*M. Greenwald*) ;
 - (b) an outline of the key prioritized issues faced in carrying out such a program – highlighting integration; (*X. Tang and J. Cary*) and
 - (c) the cross-disciplinary engagement of communities representing FES theory/computations & experiments and ASCR computer science and applied math. (*V. Chan and A. Siegel*)

- (2) FSP Management & Governance (*W. Tang*) -- Regarding the FSP Execution Plan, please describe the current view of:
 - (a) the organizational structure;
 - (b) the approach for dealing with the distributed project nature of the FSP;
 - (c) the decision-making process; and
 - (d) the flow of funds/resources from DoE-SC to the lead institution and to the collaborating research performers at other laboratories, universities, and industries.

FSP Planning Activity Milestones & Deliverables

| Fiscal Year Quarter | Q409 | Q110 | Q210 | Q310 |
|---------------------|--|---|--|--|
| Deliverables | <ul style="list-style-type: none"> ✓FSP Kickoff meeting held on July, '09 ✓Communication logistics (web-site, wikis) ✓FSP PAC organized and first meeting held (Sept.'09) ✓FSP Mission and Vision statements | <ul style="list-style-type: none"> ✓FSP FAQ's with Answers on web-site ✓Draft FSP Program Scope Document ✓Draft FSP Program Deliverables ✓FSP Briefing with DOE-SC Leadership ✓Draft FSP Production/ Customer Interface Plan | <ul style="list-style-type: none"> ✓Draft Outreach Schedule ✓Draft FSP Planning Project Plan with Deliverables & Dates ✓Draft WBS for Planning Project ✓Proto-FSP Workshop ✓FSP Project Planning Meeting ✓2nd FSP PAC Meeting (Mar.'10) | <ul style="list-style-type: none"> ✓Charge & Committee for Proto-FSP Assessment ✓Validation Best Practices ✓Data Management and Requirements Plan ✓Community Input on Science Drivers & Applications collected |
| Fiscal Year Quarter | Q410 | Q111 | Q211 | Q311 |
| Deliverables | <ul style="list-style-type: none"> ✓3rd FSP PAC Meeting (Sept. 23-24, 2010) ✓Proto-FSP Assessments Report <p>First Draft: Integrated Program Plan for 6 Science Drivers – Oct. 2010</p> <p>First Draft: WBS for 6 Integrated Plan for 6 Science Drivers – Nov. 2010</p> | <p>Request to Community for White Papers on executing the 6 SD WBS</p> <p>First Draft: (1) Rough Overall FSP Plan, including Prioritization Criteria for sequencing of Science Drivers</p> | <p>Request to Community for White Papers on Advanced Components, Software Integration, QA, and Operations/ User Support</p> <p>FSP Project Planning Community Workshop – Jan-Feb, 2011</p> <p>4th FSP PAC Meeting (March 24, 25, 2011)</p> | <p>External “Red Team” Review of FSP Plan (April, 2011)</p> <p>Delivery of Final FSP Plan to DoE-SC (July 15, 2011)</p> |

PROTO-FSP ASSESSMENT

-- Represents a key step in the continuing FSP scoping process to focus approaches for code integration

*** Proto-FSP Panel Assessment carried out (August 30 – Sept. 3) for SWIM, CPES, and FACETS projects with purpose of *“determining to what extent:*

(a) the proto-FSP’s help contribute to establishing a foundation for the FSP; and

(b) which elements of the proto-FSP’s will be most useful to the FSP.”

-- Panel: M. Zarnstorff (PPPL, Chair), V. Balaji (GFDL), B. Smith (ANL), B. Van Straalen (LBNL), P. Vashista (USC), and M. Zika (LLNL)

-- Brief summary of Panel Findings (next slide – from M. Zarnstorff)

-- *Final Panel Report to be submitted by Sept. 30 and posted on FSP Web-site*

Brief Summary of Proto-FSP Assessment

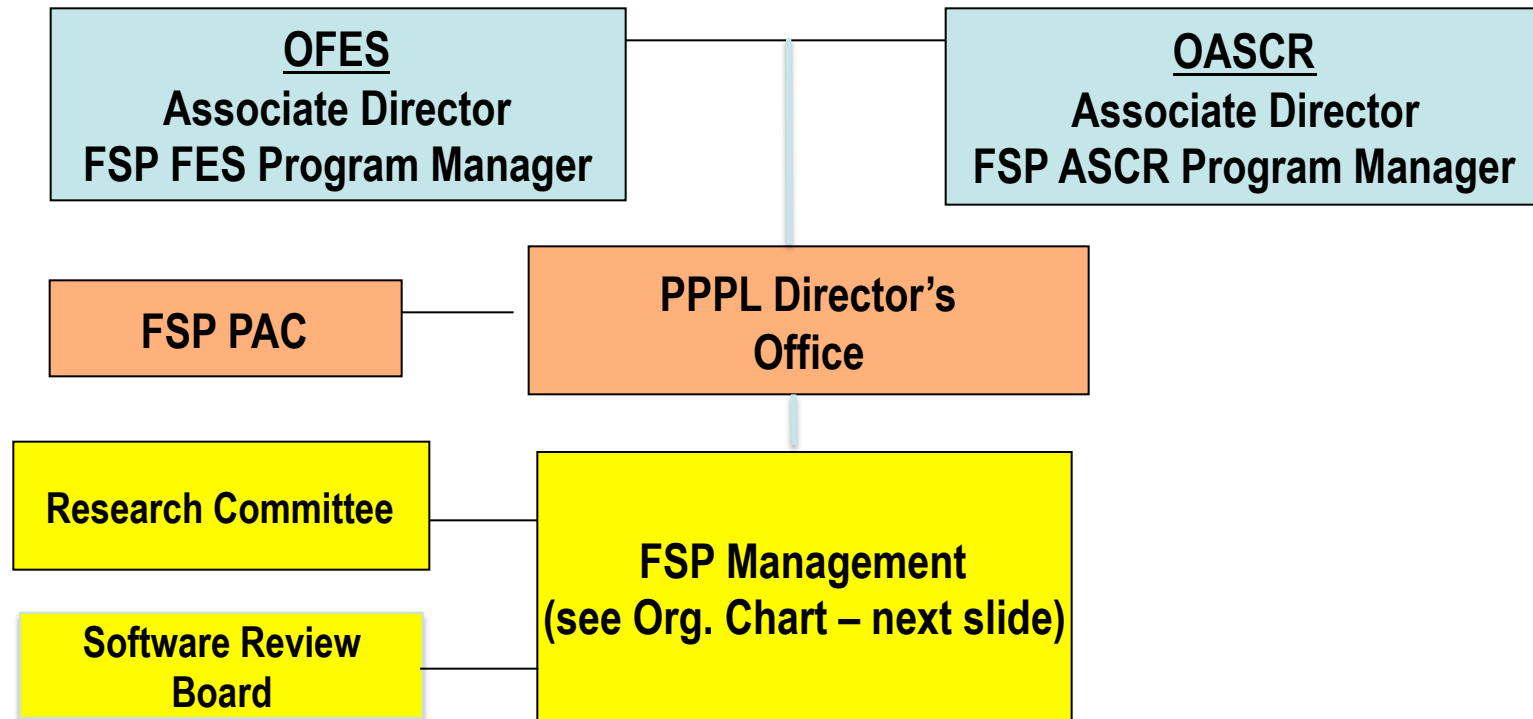
M. Zarnstorff, Panel Chair

The assessment panel found that each of the Proto-FSP's has relevant technology that may be useful as prototypes of concepts for the FSP.

Top-level recommendations for the FSP:

- Organize the FSP effort about science drivers, including their reference validation experiments,
- Produce a validated, robust set of Open Source codes available to the fusion and broader community,
- Form multi-disciplinary teams to address the breadth of science challenges,
- Adopt project management strategies that are suitable for the scale of the FSP,
- *Pursue a single software framework*, and
- Establish software development and quality assurance practices that reflect the investment being made by the FSP and the value of the decisions it seeks to influence.

FSP National Organization Chart



- **Bi-Weekly Telecons (7 persons-IPT):** *FSP FES Program Mgr., FSP ASCR Program Mgr., PPPL Deputy Director for Research, FSP Director, FSP Deputy Directors for Science and Code Architecture, FSP Project Manager*
- **FSP Management reports to PPPL Director** → National FSP as high priority responsibility for PPPL
- **FSP guidance from external PAC and internal Research Committee and Software Review Board**

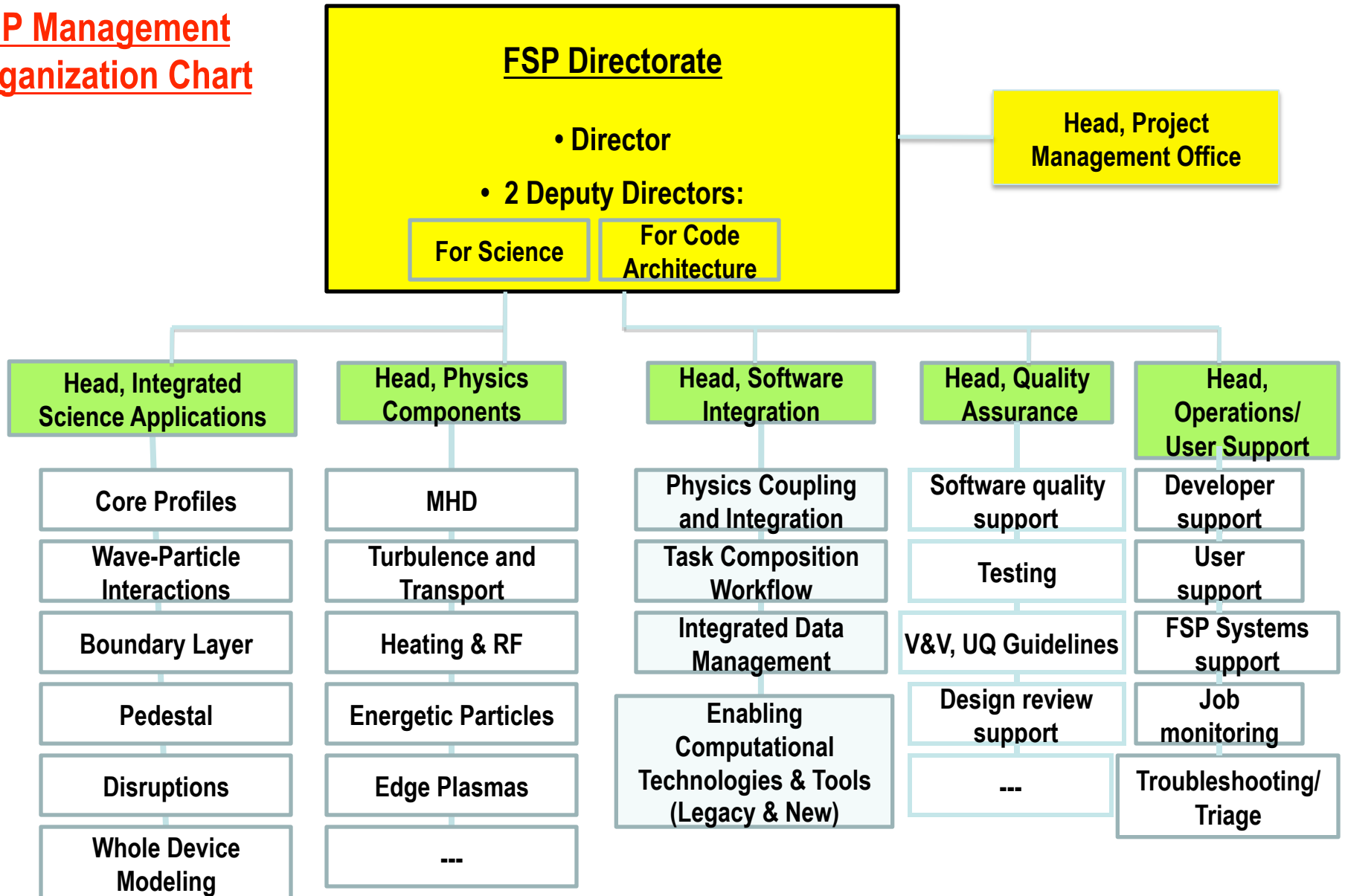
Charge 2a: FSP Organizational Structure

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-- FSP Plans & Priorities will be guided by input from:

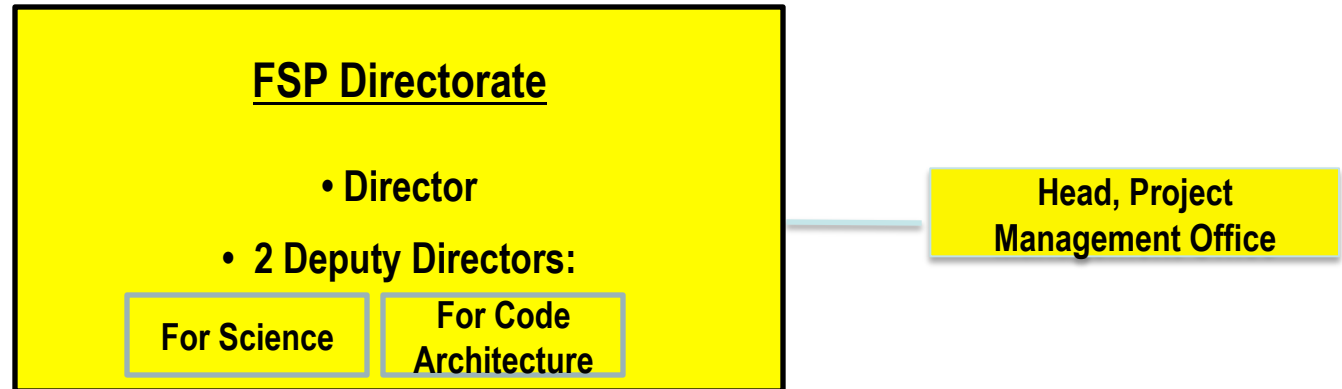
- (i) **Program Advisory Committee (PAC):** *external group of experts, reporting to the Director of the lead institution and providing advice on a broad range of technical and managerial issues. The PAC would meet approximately once per year and address a charge formulated by the Institution and FSP Directors.*
- (ii) **Research Committee:** *composed of FSP leaders (heads of integrated science applications, components, software integration, quality assurance, and operations/user support teams along with the FSP directorate) and include representatives of major collaborating groups*
 - chaired by Deputy Director for Science to help advise the Director on a broad range of research planning activities including assessment of priorities for R&D, preparing work proposals and organizing publications and presentations*
 - will discuss relevant issues and make recommendations to the FSP director – with findings and recommendations well documented*
- (iii) **Software Review Board:** *composed of designated members from other areas and chaired by the Software Quality Manager*
 - develop standards for software development and testing; review plans and progress on software quality activities across the entire FSP program and facilitate software reviews prior to release*

FSP Management Organization Chart



Charge 2a: FSP Organizational Structure

FSP Management Organization Chart



Director – Responsibility for ensuring overall scientific and software development goals of FSP are properly executed, including

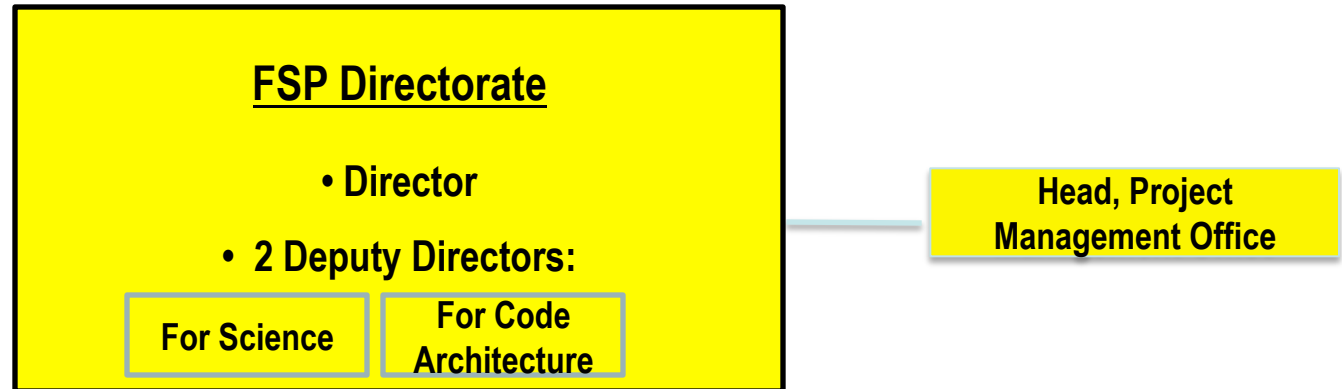
- principal contact with DoE and with home institution (PPPL) Directorate
- oversight of core FSP management team
- final decisions* *for project prioritization, funding allocations, and personnel*

*informed by external PAC and by internal Research Committee and Software Review Board

Deputy Director for Science: *Oversees Integrated Science Applications and Physics Components teams*

- drives scientific goals of FSP, ensuring application projects are well balanced and making appropriate progress
- suggests funding allocations (by area) to the Director based on the need to balance short/long-term progress, address the priorities of the Program Office, and respond to community feedback
- serves as chair of an FSP Research Committee that will advise the Director on questions of planning and priorities

FSP Management Organization Chart



Deputy Director for Code Architecture: *Oversees the Software Integration, Quality Assurance, and Operations/User Support groups*

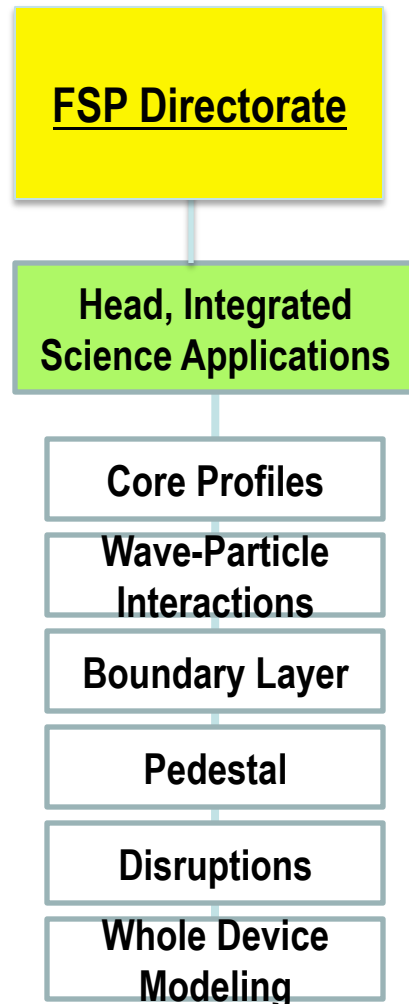
- responsible for the management of the overall FSP code repository as integrated software
- drives both the math/computer science research and applied project software goals of the project
- ensures that an integrated “community code” (suite of tools) flows from the integrated science applications projects
 - lives within a proper software development lifecycle, including documentation, testing, versioning, repository management, etc.

**** DD's for Science & Code Architecture → act as top level communication channel to ensure the cross-cutting functional groups work together in a seamless way*

Head, Project Mgt. Office: Establishes the standards, policies, & procedures to be followed for FSP project management

- coordinates project tracking & reporting for the Directorate

FSP Management Organization Chart

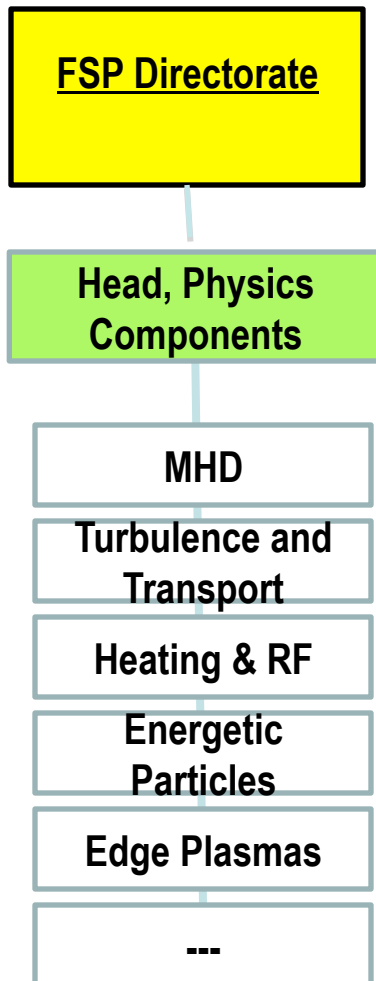


Integrated Science Applications Group comprised of the 6 Science Drivers and associated Integrated Teams including coverage of Experimental Validation, Verification, and Uncertainty Quantification

Head, Integrated Science Applications:

- Reports to Deputy Director for Science
- Oversees/coordinates the Integrated Science Applications Teams with
 - Each Application Area Lead (Core Profiles, etc.) oversees integrated team tasked to execute the WBS (work breakdown structure) for carrying out R&D needed for each of the targeted Science Drivers
 - includes developing end-to-end capabilities from scientific definition and formulation through problem verification and validation to software release
 - teams will include members matrixed from the component and integration groups to ensure that a common set of components and enabling computational tools are being developed across the FSP application projects
 - initiate release of new software capabilities to the Community in coordination with other groups

FSP Management Organization Chart

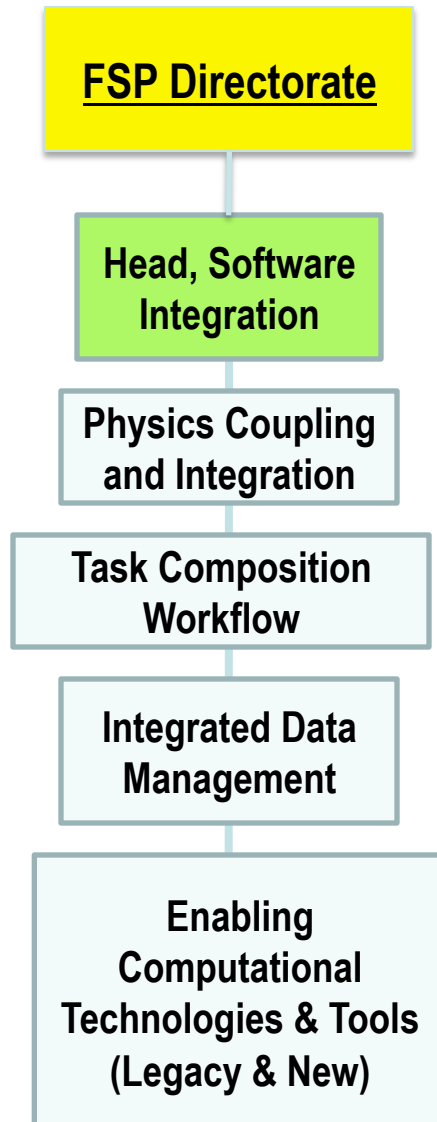


Physics Components Group identified via “gaps analysis” of SD areas of need in major physics categories (MHD, etc.) with associated team leads

Head, Physics Components:

- Reports to Deputy Director for Science
- Oversees/coordinates the teams tasked with developing re-usable physics components in coordination with the Integrated Science Application teams and in significant collaboration with the Deputy Director for Code Architecture
 - ensure that the group members targeting a given application driver are developing from and being built into a common code base
 - ensure methods embedded in the physics components are verified (vs. problem-specific verification, which is the domain of the application groups)
 - bring an eye of generality that would not otherwise drive the application leads
 - *including longer-term research not directly affecting near-term application goals but which can potentially benefit a wide range of future scenarios*

FSP Management Organization Chart

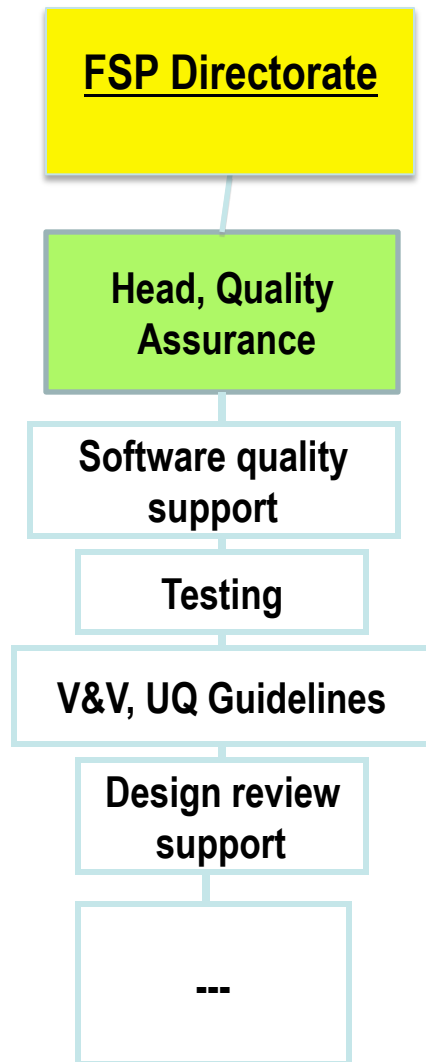


Software Integration Group comprised of teams (frameworks, task composition, workflows, etc.) charged with integrating the FSP physics components – **both “legacy” and new codes**

Head, Software Integration:

- Reports to Deputy Director for Science
- Oversees/coordinates the teams tasked with ensuring that the overall vision and end goals of cohesion, testing, and release are met in a timely manner
 - includes crosscutting teams supplying the enabling computational technologies and tools to the application teams
 - ensure minimal duplication (as with physics component group)
 - make components conceptually related: similar approaches with respect to documentation, deployment, ability to read/write same data formats, use the same mesh data types, visualization, etc.
 - manages version control and coordinates release of FSP codes initiated by Head, Integrated Science Applications

FSP Management Organization Chart

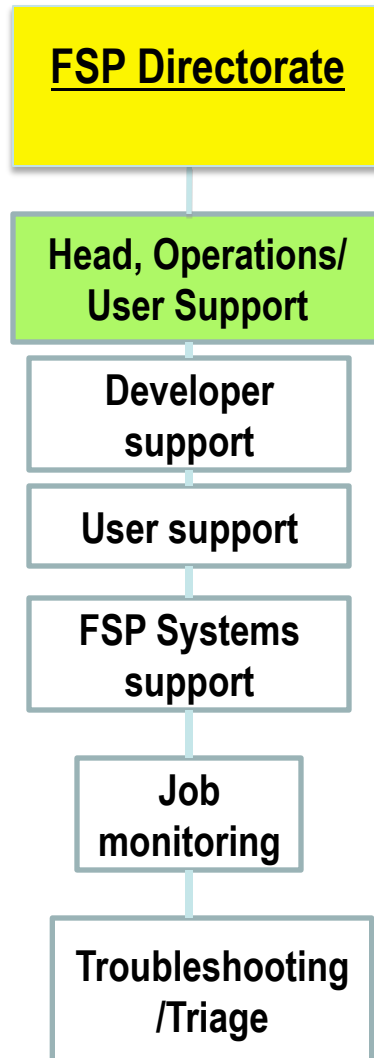


Quality Assurance Group comprised of teams ensuring the reliability of the FSP frameworks and components targeted for release to the community – including standards for V&V&UQ and internal (“alpha” testing) as well as external “beta” testing of products

Head, Quality Assurance:

- Reports to Deputy Director for Code Architecture
- Oversees/coordinates the teams tasked with Software Quality Management (SQM)
 - responsible for coordinating software QA, testing, verification and validation – with understanding that implementation of these activities would be the responsibilities of all members of the team
 - the SQM technical staff provides crosscutting tools and technologies (e.g. testing systems, etc.)
 - Head of QA also chairs a Software Quality Board, composed of designated members from other areas
 - task to develop standards for software development and testing
 - will review plans and progress on software quality activities across the entire FSP program
 - SQM would organize software reviews, prior to release

FSP Management Organization Chart



Operations/User Support Group comprised of teams organizing and coordinating the release of FSP software and an appropriate subsequent level of “customers” support

Head, Operations/User Support:

- Reports to Deputy Director for Code Architecture
- Coordinates teams tasked with responsibility for each area targeted -- *also includes documentation, bug tracking, and any other tools required to support users both internal and external to the FSP*
- Administer dedicated facilities (e.g., for data storage) if required by FSP

Charge 2b: Distributed Project Nature of the FSP

- Fundamental challenge of the FSP involves addressing *multi-institutional, multi-disciplinary issues – important to ensure concentrated level of effort*
- Associated Plan Requirements include:
 - (1) some level of *co-location* to facilitate institutional commitments and efficient team-building
 - *co-location at team level – e.g., an institution could have overall responsibility for executing a specific mission/task in box on org. chart (with support from other institutions)*
 - (2) make use of established relationships with “critical mass” -- sufficient engagement of performers
 - cannot allow low % “peanut buttering”
 - (3) optimal utilization of modern collaborative tools (video-conferences, telecons, wikis ...)
- FSP is distributed with respect to people, computational facilities, & experimental facilities (next slide) → *great need for effective collaborations, requiring:*
 - (i) *general understanding of FSP leadership roles and associated responsibilities; and*
 - (ii) *frequent communications between the nationally distributed teams -- flowing from front-lines to top management and across matrixed groups*

Collaboration With Experimental Facilities

- Discussions have progressed significantly with the major facilities to define:
 - General principles for intellectual property (IP) sharing
 - Proposed mechanisms for short-term and long-term planning
 - Roles & Responsibilities for the FSP and for experimental teams in their collaboration
 - Lessons learned from the major experimental facilities that are useful in planning the FSP R&D program– e.g. open annual community research forums
- *Draft document circulated and generally agreed on by each facility*
 - affirms need for partnerships and mutual interactions -- institutionalized through formal agreements, regular participation in planning and reporting activities, and *cross-membership in planning groups as appropriate*

Charge 2c: FSP Decision Making Process

FSP Decision Making Process: (linked to Roles & Responsibilities of leadership depicted in the Organization Chart)

Process for selection of leadership on FSP Management Organization Chart:

- FSP Planning Team already selected by DoE-SC in a peer-reviewed process
- FSP Director (Planning Team PI) and Lead Institution (PPPL) *select the Deputy Directors for Science & Code Architecture*
- FSP Director, Deputy Directors, and PPPL Director *select the Heads for Integrated Science Applications, Physics Components, Software Integration, Quality Assurance, and Operations/User Support*
- Selection of Heads of each Integrated Science Application & of individual elements under Advanced Components, Software Integration, QA, and Operations/User Support *made by above FSP Leadership following actions:*
 - (i) Integrated Program Plan (with WBS) for 6 Science Drivers announced and posted (Nov., 2010)
 - (ii) Community call for White Papers: leadership of each Integrated Science Applications (December, 2010)
 - (iii) Major Community FSP Planning Workshop – part II (late-January, 2011 at GA)
 - (iv) Community call for White Papers: leadership of individual elements under Advanced Components, Software Integration, QA, and Operations/User Support (February, 2011)

Charge 2d: FSP Flow of Funds (to be vetted with DoE-SC)

- The current Plan is for flow of funds/resources from DoE-SC → to the lead institution (PPPL) → to the collaborating research performers at other laboratories, universities, and industries

Context: *FSP as a large scientifically-driven software development “project” with proper governance and accountability*

- Guidance from DoE is that the FSP is a “Program” that should be managed as a “Project” with associated “project management” principles adopted, *including how funds will be distributed*
- Project-like timelines with associated software releases require major percentage of FSP resources be placed at Lead Institution (PPPL) administering the activity
- Lead institution (PPPL) transfers funds to collaborating labs, universities, and industries via Sub-contracts – with a favorable “flow-through” rate, e.g., 3% (the same as that for the US ITER Project Office)
- Appropriate MOU’s and formal agreements will be executed
- FSP tasks involve direct assignments as well as targeted open solicitations with associated expert reviews – all managed by the FSP project team with clear prioritization criteria evident

Charge 2d: FSP Flow of Funds (continued)

- **There has also been discussion with OFES about a coordinated external community research component of the FSP**
 - **This FSP element will be supported at an appropriate fraction of the total FSP funding level**
 - **Will involve open “calls for proposals” with delivery of considerably less time-urgent research elements -- activities that represent “higher risk with potentially higher payoff”**
 - **nevertheless requires coordination with the main FSP project**
 - **Generally more “loosely-coupled” and less amenable to being managed as a project**
 - **This more “program-like” part of the FSP would be managed by DoE-SC but will be technically coupled to the central FSP activity**
 - **a reasonable level of accountability for performance will still need to be enforced**

Highlights of Key Future FSP Project Planning Events

- **Announcement and Posting (on FSP web-site) of the Program Plan and associated WBS for 6 Science Drivers (November, 2010)**
- **Call to Community for White Papers expressing interest in leadership of each Integrated Science Applications (December, 2010)**
- **Major Community FSP Planning Workshop – part II (late-January, 2011 at GA)**
- **Call to Community for White Papers expressing interest in leadership of individual elements under Advanced Components, Software Integration, QA, and Operations/User Support (February, 2011)**
- **Final FSP PAC Meeting to discuss Draft of complete FSP Plan: March 24-25, 2011**
- **External “red team” assessment of FSP Plan (April, 2011)**
- **Delivery of final FSP Plan (with resource loaded documentation) – mid-July 2011**

A DOE-Office of Science review will be held at the end of the 2-year planning study (shortly after mid-July of 2011)

• The Final Plan for the FSP will include a PEP (Program Execution Plan) to enable prompt ramp-up in late 2011 in the event of final DoE approval.

Concluding Comments

- FSP will establish credible base of component capabilities and framework approaches to produce integrated software tools within the next 5 years to enable significant progress on each of the integrated science applications (SD's)
 - Address needs identified by “gaps analysis” of science & simulation tools required to improve fidelity
 - Implement strong Verification, Uncertainty Quantification, and Experimental Validation campaign enabled by effective partnership with experimental facilities/community
 - Identify limitations and adopt associated risk mitigation plans
- FSP scope will reflect focus on common components/integration R&D approaches to address SD's
- FSP's whole device modeling SD will unify R&D thrusts across other SD areas – i.e., physics integration area on converging paths

Response to PAC Recommendations

Science Drivers & Roadmap Elements:

- *“The PAC recommends that the FSP continue to develop a strategy and prioritized plans for realizing the capabilities for each science driver through a transparent and documented process.”*
- **Response:** See M. Greenwald presentation and Report (60 pages) completed (June, 2010), summarizing results of major FSP Planning Workshop (March, 2010) involving over 60 participants from the FES and ASCR communities
-- posted on the FSP web-site and forwarded to the PAC
- *“The requirements and opportunities for verification and experimental validation should be key elements in the selection of science drivers and roadmaps, including outreach to US and international partners for long duration discharge data.”*
- **Response:** Progress on this topic as well as other specific Science Drivers PAC recommendations are addressed in the FSP Planning Workshop Report & in the presentation at this meeting by M. Greenwald

Response to PAC Recommendations

Community Engagement:

- *“The FSP has made significant strides in community outreach the PAC recommends a continuation of these activities, especially the site visits and workshops, which are productive avenues for community engagement. ”*
- **Response:** (since March 2010 PAC meeting)
 - *Site visits* made to ORNL (5/10) , LBNL (5/10), JET (UK-6/10) and U. Colorado (8/10)
 - *FSP participation in Workshops* including DoD-WTEC2 (DC-6/10), NERSC (DC-8/10), and LCF (ORNL-8/10)
 - *FSP Remote Seminar (Telecon)* with national FES Theory Coordinating Committee (June, 2010)
 - *NEXT FSP Planning Workshop including major community engagement targeted for end of January, 2011*

Response to PAC Recommendations

FSP Mission:

- *“The PAC would like a clearer articulation of what is planned for the FSP scope. Plans should be developed for assessing to what extent existing codes can be integrated into the FSP software distributions and to what extent the FSP should develop entirely new codes.”*
- **Response:** See afore-noted FSP Planning Workshop Report (distributed to the PAC and posted on FSP web-site subsequent to the previous PAC meeting).
 - Major continuing integrated planning of work-scope for the 6 FSP Science Drivers involves significant level of focus (M. Greenwald presentation)
 - **First Draft: Integrated Program Plan for 6 Science Drivers – Oct. 2010**
 - **First Draft: WBS for 6 Integrated Plan for 6 Science Drivers – Nov. 2010**
 - FSP scope also addressed in other scheduled presentations
 - e.g., Physics Components Talk (X. Tang): examples of results via “gaps analysis” of physics components needed to address FSP SD’s
 - Proto-FSP Assessments: Key step in continuing FSP scoping process to focus on most promising approaches for code integration

Response to PAC Recommendations

Summary:

- *“The FSP Planning Project (PP) has made good progress since the last meeting in September, 2009, as noted in the body of the report. For the next meeting in September, 2010, the PAC is looking forward to seeing a description of the priorities and other progress, especially management and organizational structure, at the next advisory panel meeting.”*
- **Response:** This has led directly to the Charge for the current PAC meeting.