NASA John H. Glenn Research Center
Technical Authority Implementation Plan

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Concurrence by:

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I. Preface

P.1 Purpose

This document presents the plan for implementing the Technical Authority component of NASA's Engineering Technical Excellence. The management system in this plan governs the formulation, approval, implementation, and evaluation of all aspects of Technical Authority at the NASA John H. Glenn Research Center (GRC).

P.2 Applicability

a. This document applies to NASA GRC space flight programs, projects, personnel, and service providers at Lewis field and Plum Brook Station to the extent specified in their contracts with NASA, according to the criteria included herein.
b. This document shall apply to all current and future space flight programs and projects as defined in NPD 7120.5, which, at a minimum include:

    - spacecraft,
    - launch vehicles,
    - instruments developed for space flight programs and projects,
    - research and technology developments funded by and to be incorporated into space flight programs and projects,
    - critical technical facilities specifically developed or significantly modified for space flight systems,
    - ground systems that are in direct support of space flight operations,
    - reimbursable space flight programs/projects performed for non-NASA sponsors,
    - associated institutional investments or other NASA investments at the discretion of the Center Director or higher authority.

P.3 References and Definitions

P.3.1 Applicable Documents

a. NPD 1000.0, Strategic Management and Governance Handbook
b. NPD 1001.0, 2006 NASA Strategic Plan
c. NPR 7120.5, NASA Space Flight Program and Project Management Requirements
d. NPR 7123.1, NASA Systems Engineering Processes and Requirements
e. NPR 8700.3, Safety and Mission Assurance (SMA) Policy for NASA Spacecraft, Instruments, and Launch Services
f. NPR 8820.2, Design and Construction of Facilities
g. NASA Interim Directive (NID) NM7120-38, NASA Engineering Technical Excellence
h. GLC-EMC-1000.1, Engineering Management Council

P.3.2 Reference Documents

a. Columbia Accident Investigation Board Report, vol. 1, August 2003

P.3.3 Definitions

Technical Excellence

Technical Excellence is a philosophy for assuring the highest probability of success for NASA programs and projects. It is implemented by determining and applying the correct engineering processes, practices, and decision making procedures that are needed for all of NASA programs and projects. It also includes the necessary training and development of the engineering workforce.

Technical Authority

Technical Authority (TA) is a responsibility delegated to selected Engineering and Safety & Mission Assurance personnel and an element of Technical Excellence. These institutional authorities are established parallel to program/project management authority to better achieve balance between the needs of a program or project to achieve programmatic efficiency and institutional need to assure compliance with applicable standards of professional practice in the implementation and execution of safe and successful flight programs and projects. The Technical Authority framework provides for an organizationally and financially independent voice, equal to programmatic authority for engineering, safety and mission assurance, and health and medical requirements. It defines the delegation of responsibility for setting and enforcing technical and safety standards and engineering requirements. It defines the process for elevating issues and resolving disputes between the programmatic and technical authorities or among the technical authorities.

The Technical Authority personnel are the appointed individuals who execute and maintain technical authority by setting and controlling technical and safety requirements, respectively, and by approving any variances from such requirements at the level commensurate with their authority. In this document (consistent with NPR 7120.5), the term Technical Authority is used to refer to such an individual or to the Authority itself, but is also used (without capitalization) to refer to elements of the technical authority process. The technical authority flows from the NASA Chief Engineer and NASA Chief Safety and Mission Assurance Officer to the GRC Center Director for activities implemented within the Center. The engineering technical authority flows from the GRC Center Director through the GRC Director of Engineering to Project Chief Engineers (PCE's) and Lead Discipline Engineers. SMA technical authority flows from the GRC Center Director through the GRC Director of SMA and to project Chief Safety and Mission Assurance Officers (CSO's). The GRC mission assignments are unlikely to require invoking Health and Medical Technical authority, but any such issues also are delegated from the Center Director to the Director of SMA.

Project Chief Engineer

The PCE is the subject matter expert in a specific system or related family of systems. The PCE executes the engineering technical authority for the assigned program, project or element at the Center. The PCE will serve as system Technical Authority and as the single point of contact for the execution of the engineering technical authority process for the assigned program, project or element at the Center.

Project Lead Engineer

At GRC, the title of Project Lead Engineer (PLE) might be substituted for PCE within lower level projects or elements that require a designated lower level equivalent of the PCE to lead engineering efforts. Organizationally PCE's are part the GRC Chief Engineers Office, whereas PLE's reside in their home organization and are not delegated Technical Authority. PLE's report to a CE designated to provide Technical Authority for each project or element led by a PLE.

Discipline Lead Engineer

The Discipline Lead Engineer (DLE) is the subject matter expert in a specific engineering discipline or set of related disciplines who is delegated discipline Technical Authority, and executes the discipline technical authority with respect to those discipline principles, standards and practices that are applied to any specific program or project.

Lead Engineer and Engineer

Lead Engineers (LE) lead discipline or subsystem teams and are responsible for integrating and ensuring delivery of quality discipline or subsystem products (within schedule and resource commitments). Engineers are responsible for providing engineering products that conform to engineering standards, requirements and processes. Both Lead Engineers and Engineers are responsible to identify and report non-conformance issues and risks to both the CE / PLE (System) and DLE (discipline) for TA.

Chief Safety and Mission Assurance Officer

The CSO executes the SMA technical authority for the assigned program, project or element at the Center. The CSO is the SMA subject matter expert in a specific system or related family of systems for the projects assigned. The CSO will serve as the SMA Technical Authority and as the single point of contact for the execution of the SMA technical authority process for the assigned program, project or element at the Center.

Engineering Management Council

Co-chaired by the by the Director of Engineering, and Director of Safety and Mission Assurance, the Engineering Management Council is chartered to evaluate technical, safety and management issues within engineering or safety and mission assurance, and provide solutions or resolution, as well as provide technical direction, advice and counsel to the PCEs, DLE's and CSO's. The Council integrates varying engineering and SMA positions into a comprehensive solution and makes recommendations as necessary to the Center Director, in her/his capacity, as the Center Technical Authority.

Senior Management Council

Chaired by the Center Director, or his designee, the Senior Management Council adheres to principles and requirements described in NPR 7120.5. It is chaired by the Center Director, and provides oversight evaluation and guidance for all mission, institutional and engineering activities at the Center.

Waiver

A waiver is a documented agreement intentionally releasing a program or project from meeting a requirement.

II. INTRODUCTION

The NASA HQ Office of the Chief Engineer (OCE) is responsible for assuring technical excellence in the design and engineering activities across NASA's programs and projects. The NASA HQ Office of Safety and Mission Assurance (OSMA) is responsible for assuring technical excellence in the SMA activities across programs and projects. An important aspect of technical excellence is implementation of Technical Authority. Impetus for the Technical Authority framework originated in NASA's prior programs, especially in the history of the Challenger and Columbia accidents. As an initial stand-alone element of this excellence initiative, the OCE and OSMA require each field center to document an integrated implementation plan to describe its own technical authority process (ref. e). Key points for successful implementation include the identification of appropriate Technical Authorities, budgeting necessary and independent funding of these activities (ref. f), consideration for how to organize to implement technical authority, concurrent adoption and review of the Agency documents NPR 7120.5 (ref. c), NPR 7123.1 (ref. d), NPR 8700.3 and other related NPR's, appropriate budget controls, and training for engineering, SMA and other Center personnel to promote the execution of the technical authority process.

Within the NASA Glenn Research Center, the Director of Engineering has been assigned the responsibility to maintain and execute the engineering technical authority process. The Director of Safety and Mission (SMA) assurance has been assigned the responsibility to maintain and execute the SMA technical authority process. Engineering technical authority is implemented from the Director of Engineering through the Center Chief Engineer Office (CEO), the line organization, and through engineering processes. The head of the CEO serves as Center Chief Engineer (CCE), and the CEO is comprised of a relatively small number of permanently assigned senior engineers, and support staff to perform two functions: 1) furnish programs and projects with Chief Engineers who, among their duties, lead the project engineering teams, and serve as system Technical Authority; and 2) to manage Agency compliant engineering procedures and standards processes for GRC. The CEO organization is independent of the program and project organizations. The CEO reports to the Center Director through the Director of Engineering. The engineering line organization supplies engineers and needed engineering products to projects. Discipline Technical Authority is distributed primarily to engineering Branch and Division management within the Engineering Directorate. Discipline Technical Authority is also distributed to Branch Chiefs of test engineering within the Facilities and Test Directorate; and distributed to Branch Chiefs of engineering research and technology Branches within the Research and Technology Directorate.

NASA Chief Engineer approval is required for the individual(s) selected for the position(s) of Engineering Director (or equivalent technical leader) at the Center and for Engineering Technical Authority position(s) for each program and Category 1 project1 (i.e., Chief Engineers). The NASA Chief Engineer will be informed of the appointment of individuals assigned as Engineering Technical Authority for Category 2 and Category 3 projects, and of other individuals selected for Engineering Technical Authority positions at the Center. The Center will maintain a current list of key personnel in positions of Technical Authority (e.g., Engineering Directors, program and project

Chief Engineers, Lead Discipline Engineers).

SMA technical authority is implemented through assignment of Chief Safety and Mission Assurance Officers to serve as SMA technical authority for projects / programs. SMA Line Management holds SMA discipline and institutional technical authority, including where needed, health and medical through the Chief, Safety, Environmental and Health Division.

NASA Chief, OSMA, approval is required for the individual(s) selected for the position(s) of Safety and Mission Assurance Director (or equivalent technical leader) at the Center. The NASA Chief, OSMA, will be informed of the appointment of individuals assigned as the Safety and Mission Assurance Technical Authority at the Center. The Safety and Mission Assurance Director will maintain a current and accessible list of key personnel in positions of Technical Authority.

Engineering and SMA processes are documented in the Center Business Management System to assure compliance, the elucidation of issues to be subject to technical authority principles, and the overall administration of technical authority at GRC. Oversight for the execution of the principles of technical authority is within the purview of the Engineering Management Council (EMC) (ref. g).

III. DESCRIPTION OF THE TECHNICAL AUTHORITY PROCESS

The NASA governance model employs checks and balances between programmatic and institutional organizations, to ensure that decisions have the benefit of different points of view, and are not made in isolation (ref. c). Consequently, NASA has adopted two basic authority processes: the programmatic authority process and the technical authority process.

A program or project manager has overall programmatic authority responsibility and accountability for the program / project execution and success in conformance with governing requirements. The achievement of these responsibilities will require the overall accomplishment of the technical, schedule, and cost objectives. The technical authority process provides for appointment of individuals at different levels of responsibility who provide an independent view of matters within their respective areas of expertise. A key aspect of this process is that these appointed individuals are funded independently of the program / project. In the technical authority process, their responsibilities include approving changes to, and waivers of all TA-originated requirements and assuring that changes to, and waivers of, technical requirements are submitted to and acted upon by the appropriate level. Individuals assigned as TA for programs / projects serve as members of program / project control boards, change boards, and internal review boards. At GRC, these individuals are Chief Engineers for Engineering TA, and Chief Safety and Mission Assurance Officers for SMA TA.

This day-to-day involvement in program / project decision making and review boards should ensure that any significant views from TAs will be available to a program/ project in a timely manner and should be handled during the normal program / project processes. Under the infrequent circumstance that a Technical Authority or Program / Project Manager may disagree on a proposed

programmatic or technical action and judge that the issue rises to a level of significance that the next higher level of management should be involved, the technical authority resolution process is invoked. The result is that the mandated independence between the project manager and the performing technical organizations require that issues of schedule and cost be resolved by the project manager by using a project change control board, while disputed technical issues are resolved through the CEO, and disputed SMA issues are resolved through the CSO, using the technical authority process described herein.

The current organizational architecture of the Glenn Research Center maintains the separate lines (between the Technical Authority and the program/project management) up to the Office of the Center Director. Any requesting individual can raise technical issues, or dissenting views, to the Project Chief Engineer or Project Lead Engineer. Likewise, any requesting individual can raise SMA issues to the CSO. The PCE, or CSO will be the Technical Authority agent until the issue is resolved. For projects that do not yet have an assigned PCE or PLE, individuals can raise technical issues or dissenting views through appropriate line management to the CCE. The CCE will then appoint a Technical Authority agent for resolution for the issue with concurrence of the Director of Engineering.

The issues can be resolved by one of two ways. First, the Technical Authority (TA) may establish a mutually acceptable solution among all parties. The TA decision is to be based on consideration of precedent, the inputs of the requesting individual, the DLE, the project discipline engineer, and the TAs prior experiences, training and expertise. The engineering TA will use Engineering Review Boards (ERB) as a mechanism to provide sufficient discussion of the technical issues to arrive at a recommended technical solution. The SMA TA will utilize an Organizational Review Board (ORB, which is an SMA Review Board) or the ERB as the mechanism. Second, if a satisfactory conclusion can not be reached, then the TA will utilize the services of the EMC (ref h.), co-chaired by the Director of Engineering and Director of SMA to evaluate the options associated with the issues and risks, and ultimately to arrive at a recommendation for resolution of the technical issue either by agreement of the parties or by elevation of the issue to the next TA level. An issue can be raised up to the Center Director whenever an impasse is reached between decision choices, or when there continues to be a disagreement between the project manager and the TA. The Center Director will issue a finding, which can only be elevated by the project manager through the programmatic chain of command to the next decision level. For the project manager, this path flows up to the Program Manager to the Mission Director and ultimately to the Office of the Administrator. For the engineering TA, the path is from the Center Director to the HQ OCE. For the SMA TA, the path is from the Center Director to the HQ OSMA. The Directors of Engineering and SMA have regular reporting paths directly to HQ OCE and OSMA to provide TA status. The Technical Authority, in support of the ultimate decision at the Administrator level, will brief the Office of the Chief Engineer and Office of Safety and Mission Assurance at NASA HQ. Figure 1 outlines the issue elevation paths.

In all cases, a decision is to be based solely on the merits or demerits of the case. The basis for making/achieving resolution of the contested issue will consider four factors in priority order. First, matters of safety will be considered via interaction with the Safety and Mission Assurance Office (See Section V). Second, all issue resolutions should be physics based, i.e., model results and experimental data will be used to the maximum extent possible. Third, methodologies of

probability based risk assessment may be employed to clarify and categorize the possible options and choices. Fourth, generally accepted engineering practices will be employed. A brief description of a process for initiating and elevating issue resolution is contained in Appendix 3.

All processes are inherently more robust if they are based on a series of checks and balances. The steps described above contain checks and balances for issues that are of a technical nature. Often, today's complex project objectives are a mixture of technical, societal, and political factors. This will occasionally give rise to a claim of exceeding authority. Issues that fall into this category should be appealed to the Center Director to determine if an issue should or should not fall under the principles of Technical Authority. Any such determination should have automatic Agency OCE review. If the OCE finds that not all criteria were considered in the determination, it can order a new determination, using consideration of all factors.

IV. OVERALL FRAMEWORK FOR THE CENTER ENGINEERING ORGANIZATION

The flow of responsibility for engineering technical authority, reporting authority, and matrix support is conceptually depicted in Figure 2. The organization of the Engineering Directorate is depicted in Figure 3, showing line, CEO and Management Integration Office. Matrix assignments of engineering personnel to projects, under technical leadership of a project Chief Engineer, will be extensively utilized to fulfill the precepts of technical authority, and to assure the integrity of the engineering discipline organizations separate from the program / project organizations. These matrix-engineering personnel organizationally report to engineering line management who serve as DLE TA. GRC has significant engineering responsibility residing outside the Engineering Directorate in the Facilities and Test Directorate and in the Research and Technology Directorate. TA is delegated also to the portion of line management in each of those organizations who serve as branch chiefs responsible for providing engineering discipline support to programs / projects to ensure full coverage of the TA at the Center.

A primary objective of the technical excellence/ technical authority is to ensure that cost and schedule pressures do not unduly affect the decision making process and inadvertently compromise technical decisions necessary for proper hardware development and/or safe flight. To that end, the Technical Authority is responsible and accountable for setting and enforcing all technical requirements and participates with the programs/projects in setting both engineering standards and program/project-derived technical requirements.

The Center Chief Engineer will be responsible for both the strategic and day-to-day needs of the CEO. The Center Chief Engineer will report to the Center Director, through the Director of Engineering. In addition the Center Chief Engineer will serve as the primary representative to execute CEO functions, meetings, and planning teams, as formed by the CEO to further the development of the concept of technical authority within the Agency. The CEO also is responsible for managing the development and maintenance of engineering processes and procedures and the engineering standards program to assure compliance with Agency requirements and maintain Center engineering standards of professional practice in support of both technical excellence and technical authority.

PCEs are selected for particular projects on an as-needed basis. These selectees will be assigned to the CEO and given matrix assignment into the project for the duration of their posting to a particular program or project as the PCE. At the conclusion of the program or project, the PCE could be reassigned to a new project or "return" to the line organization for a new assignment. These PCEs will be under the guidance of the CEO for matters relating to the execution of the processes for engineering technical authority.

Engineering line management, fulfilling technical excellence, is responsible for delivery of engineering products in conformance with project requirements including schedule and resources. This is accomplished through supervision and assignment of discipline engineering staff to the projects, and through acquisition of any support required beyond the direct civil servant staff necessary to deliver on commitments to programs / projects. In the technical authority role, engineering line management establishes and maintains discipline standards of professional practice, including ensuring compliance with Agency and Center standards within their discipline, and rendering judgment on the acceptability of waivers consistent with their delegated authority.

Administrative and work force planning support will be provided through MIO in coordination with typical GRC support offices. TA Funding will follow processes developed by the HQ OCE, and be included in the Center Management and Operations (CM&O) account. (See Section VII.)

V. OVERALL FRAMEWORK FOR CENTER SMA ORGANIZATION

The GRC Safety and Mission Assurance (SMA) organization operates in concert with the Engineering organization to implement Technical Excellence and Technical Authority. The two organizations will partner to educate, mentor, and affect Safety-related areas. Assigning engineering personnel to all hazards, integrated hazards, and FMEA teams strengthen the Engineering and SMA relationship. The flow of responsibility for SMA technical authority, reporting authority, and matrix support is conceptually depicted in Figure 4. The SMA organization is depicted in Figure 5. SMA CSO's exercise SMA Technical Authority (TA) on Programs and Projects through serving as members of ERBs, Design and Milestone Review Boards, PRBs and by making independent assessments of project compliance with SMA requirements. Therefore, all Safety, Reliability, Quality, and other design requirement compliance approaches, waivers, and deviations are subject to the concurrence of both the GRC Chief Engineers and the GRC SMA CSMAOs.

The GRC SMA CSO's are assigned SMA Technical Authority responsibilities as detailed in GRC SMA-level directives and execute those responsibilities for NASA GRC programs/projects under the auspices of the Program CSO hierarchy. Higher-level CSO's (Level 0, I, II, etc.) delegate authority for approvals and waivers of SMA and other SR&Q-related applications and requirements to lower-level CSO's.

The Director, GRC SMA co-chairs the GRC EMC, which is responsible for exercising TA Management oversight at Glenn up through to the Center Director and/or the applicable Program Engineering and SMA Technical Authorities.

VI. ROLES AND RESPONSIBIITIES

a. Center Director

The NASA will comply with the CAIB Recommendation R7.5-1 by establishing and supporting technical excellence. In the NPD 1000.0 Strategic Management and Governance Handbook, the Center Director position is a NASA Administrator direct report, and a peer with the Mission Director Associate Administrators. The Center Director is responsible and accountable for establishing and maintaining the institutional capabilities that are required to support programs, projects, and missions. These responsibilities include the engineering capabilities required to implement and execute technical excellence, approve the application of technical requirements, approve variances, adjudicate technical conflicts, and verify readiness. The Center Director is the Technical Authority for the Glenn Research Center at both Lewis Field and Plum Brook Station. The Center Director has delegated day-to-day technical excellence/technical authority and accountability for engineering to the GRC Director of Engineering and for SMA to the GRC Director of SMA. The Center Director or Center Deputy Director will, when necessary, chair the Senior Management Council to adjudicate conflicts and evaluate technical issues, positions and dissenting opinions necessary for technical decision-making involving Technical Authority to assure safety, reliability and mission success. The Center Director, through the Engineering Director, will, assign the engineering leadership, including branch managers and/or their technical assistants, to the Center's Discipline Lead Engineer and Chief Engineer TA roles, and likewise through the SMA Directorate, will assign the SMA leadership to their SMA TA roles.

b. Director of Engineering

The Engineering Director, as delegated by the Center Director, is responsible and accountable for the implementation and execution of engineering technical excellence/technical authority. While technical excellence encompasses the technical authority, the Engineering Director has dual responsibility: assigned technical authority and institutional engineering leader. The Director will engage in these dual responsibilities independently at times, and integrally, at others. The Engineering Director will co-chair the EMC. This Council is chartered to evaluate technical issues, engineering management issues, products and solutions, as well as provide technical direction, advice, and counsel to the PCEs, PLE's, DLE's and CSOs . The Council integrates varying engineering positions into a comprehensive engineering solution, when required. The Director is responsible for engineering capabilities required to implement and execute technical excellence, approve the application of technical requirements, approve variances, adjudicate technical conflicts, and verify readiness through the PCEs' signature on Level III Certificate of Flight Readiness (CoFR) documents. Institutional technical excellence functions include engineer development and training, infrastructure readiness and applicability, engineering tools and equipment availability, engineering collaboration, discipline expertise and succession planning, and creating a healthy environment of technical openness and debate. Engineering management includes technical standards, policy and processes, engineering resource allocations, priorities, and conflict resolution.

c. Center Chief Engineer

The Center Chief Engineer will serve as the head of the CEO. The major duties of the Center Chief Engineer are to organize and manage the CEO, including the management and supervision of the permanent staff assigned to the CEO and the overall responsibility for execution of the technical authority process. This responsibility includes the development of processes for execution of the engineering technical authority.

The Center Chief Engineer will serve as the primary executor and process controller for activities associated with technical authority. The primary responsibility for assuring the execution of the NASA NPR 7120.5 and NPR 7123.1 will be assigned to the CEO. Training of Project Chief Engineers / Project Lead Engineers will be organized by the Center Chief Engineer to assure their knowledge and compliance with the NPRs prior to their assignment to a project.

A primary function of the CEO is the management of engineering requirements, standards, and the control of waivers thereto. The Center Chief Engineer will develop and maintain processes for requirements definition and management that are consistent with general systems engineering principles in NPR 7123.1. The Center Chief Engineer will assure that the Project Chief Engineers are appropriately educated in the requirements process. Control of engineering technical requirements and standards under the established Technical Authority are the responsibility of the PCE throughout the life cycle of the project.

The Chief Engineer manages the process for the EMC to develop resolution to technical issues. The Center Chief Engineer serves as Executive Secretary to the EMC. Proceedings and decisions will be documented and configuration managed by the efforts of the Center Chief Engineer.
All technical authority processes will be managed and maintained current by the Center Chief Engineer. Appropriate activities will be conducted to assure these processes are consistent with Agency practices and the directions from the OCE.

The Center Chief Engineer shall manage process activities for issue/ dispute resolution. Oversight of the process, including the development and evolution of metrics, shall be a primary responsibility of the CEO.

The Center Chief Engineer shall periodically promote educational opportunities for the dissemination of technical authority principles, information, and activities. These may include the sponsoring of enrichment classes, training seminars, or topical presentations in support of major Agency initiatives.

d. Project Chief Engineer

The Project chief engineers will be the single point of contact for program/project matters involving technical authority. Typically, talent, skills, previous experience, and development assignment opportunities are all factored into the selection of a PCE. The mastery of the engineering technical authority process will add to the qualifications required by a PCE. The engineer assigned to such a position will need training in the NPR 7120.5 and NPR 7123.1, and in the principles of issue/ dispute resolution, as developed by the CEO.

The PCE will execute the technical duties typically expected from the primary engineering authority assigned to a project. The key activities of the PCE that fall under the CEO area of responsibility are the establishment of the project engineering processes, standards, specifications, rules, practices, etc. (ref.c), leadership of project engineering teams, the execution of issue resolution for technical authority, as described in the CEO developed process documents.
Also included is the signature authority for the System Engineering Management Plan, plans for System Requirements Review, Preliminary Design Review, Critical Design Review, and Flight Readiness Review. Development of engineering team working relationships and task assignments will be the responsibility of the PCE. Other project formulation and implementation activities within the scope of Center Engineering assigned to projects are governed by the program and project plans, and by the content of the systems engineering management plan.

The assignment of the PCE will continue, normally until the conclusion of the project activities, at the end of the defined project life cycle. The PCE will end the matrix assignment to the project and be subsequently available for new assignment. In unique circumstances, possibly through preference or need, the PCE will be replaced in mid-project. Typical management responsibilities will govern such actions.

e. Project Lead Engineer

The Project Lead Engineers will be the single point of contact for program/project matters involving technical authority where projects (including subprojects) are not of sufficient magnitude to warrant assignment of a Project Chief Engineer. PLE's are not funded independent of the project, but shall serve as the project engineering team's lead and conduit to the OCE. Typically, talent, skills, previous experience, and development assignment opportunities are all factored into the assignment of a PLE. PLE's will be assigned an interface within the OCE to enable implementation of technical authority responsibilities of the OCE. The engineer assigned to such a position will need training in the NPR 7120.5 and NPR 7123.1, and in the principles of issue/ dispute resolution, as developed by the CEO.

The PLE will execute the technical duties typically expected from the primary engineering authority assigned to a project. Briefly, these include duties of insight, oversight, development of task activities and responsibility for task execution. Development of engineering teams and tasks assignments will be the responsibility of the PLE. Other project formulation and implementation activities within the scope of Center Engineering assigned to projects will continue to be governed by the program and project plans, and by the content of the systems engineering management plan.

The key activities of the PLE that fall under the CEO area of responsibility are the implementation of the engineering design processes, standards, specifications, rules, practices, etc. (ref.c), leadership of project engineering teams, as well as working with the CEO as required for technical authority / issue resolution, as described in the CEO processes documents.

The assignment of the PLE will continue, normally until the conclusion of the project activities, at the end of the defined project life cycle. The PLE will end the matrix assignment to the project and be subsequently available for new assignment. In unique circumstances, possibly through preference or need, the PLE will be replaced in mid-project. Typical management responsibilities will govern such actions.

f. Discipline Lead Engineer

The Discipline Lead Engineer (DLE) is instrumental in establishing technical requirements and ensuring that the appropriate specifications and standards are applied in the correct manner during early phases of program/project development. As the project develops, the DLE continues to exercise authority for the interpretation, changes, and variances of requirements related to the responsible discipline. The DLE works closely with the chief engineers to ensure that technical variances to the requirements are technically acceptable and that the associated risk is identified. The DLE can be a Division or Branch Chief, within the implementing organization management chain, or in a few cases, DLE can be a non-supervisory engineer due to his/her attained level of specific expertise. In the case where the DLE is line management, the primary duties and responsibilities are to deliver technical excellence consistent with requirements to programs / projects through effective application of their staff matrixed to programs / projects. Non-supervisory DLEs deliver technical excellence through their personal efforts on programs/projects. DLEs, through their day-to-day and strategic involvement with engineering staff who are assigned to multiple programs / projects, and through participation in processes managed by the CEO, have involvement necessary to perform technical authority responsibilities.

The DLEs support the PCEs and all otherwise assigned engineers, and have technical authority for waivers, deviations, and exceptions to discipline-specific requirements applied to GRC programs and projects. DLEs will receive coordination and guidance for the execution of technical authority responsibilities from the GRC CEO, within the Engineering Directorate.

The DLE will support the CE and provide technical application expertise to the application of specifications and standards. New standards and any tailoring (currently imposed or new) required for a specific program or project will be coordinated with discipline engineers assigned to that program/project and approved by the Center Chief Engineer. The DLE must document all methodologies, actions/closures, and decisions. Included in the documentation should be the circumstances surrounding the issue, technical positions (including dissenting opinions), and the logic used for final decision making. Precedent setting decisions, e.g., expanded technical envelopes, sensitivity data, and technical requirements that supersede other imposed requirements, are to be documented. Lessons learned and their associated recommendations form the basis for changing or improving technical requirements that may be applicable to other programs/projects. Applicable standards and other documentation updates should also be initiated by the DLE so that the lessons learned can be incorporated into the Agency's way of doing business.

g. Lead Engineer and Engineer

The Lead Engineers (LE) lead discipline or subsystem teams and are responsible for ensuring and integrating quality discipline or subsystem products (including schedule and resources). Engineers are responsible for providing engineering products that conform with engineering standards, requirements and processes and with SMA standards, requirements and processes. Both Lead Engineers and Engineers are responsible to identify and report non-conformance issues and risks to both the CE / PLE (System) and DLE (discipline) for TA. Any non-conformance issues and risks associated with safety and mission assurance should be reported to the CSO and CE / PLE. Although engineers are assigned to projects, funded by projects, and work under the direction of project management, they implement technical excellence, and they form a crucial link in the

technical authority process by their responsibility to implement their engineering efforts consistent with institutional engineering practices and standards, that comprise professional standards of practice, and by their responsibility to communicate effectively with the project Chief Engineer and appropriate Discipline Lead Engineers and Chief Safety and Mission Assurance Officers.

h. Director of Safety and Mission Assurance

The Safety and Mission Assurance Director, as delegated by the Center Director, is responsible and accountable for the implementation and execution of SMA technical excellence and technical authority. While technical excellence encompasses the technical authority, the SMA Director has dual responsibility: assigned Technical Authority and institutional SMA leader. The Director will engage in these dual responsibilities independently at times, and integrally, at others. It is the responsibility of the Director, SMA, to assure these functions maintain the independence necessary to provide the integrity vital to SMA. This is accomplished by judicial assignment of resources and limiting Chief Safety and Mission Assurance Officers to Management or Program/Project SMA Management roles designed to restrict the cross-pollination of "work product" with the "oversight" and independent assessment they provide. The SMA Director will ***co-***chair the EMC. The Director is responsible for SMA capabilities required to implement and execute technical excellence, approve the application of SMA requirements, approve variances, adjudicate technical conflicts, and verify readiness through the CSMAOs' participation in project boards, reviews, and signature on Level III Certificate of Flight Readiness (CoFR) documents. Institutional technical excellence functions include engineer development and training, infrastructure readiness and applicability, SMA tools and equipment availability, collaboration, discipline expertise and succession planning, and creating a healthy environment of technical openness and debate. SMA management includes SMA standards, policy and processes, SMA resource allocations, priorities and conflict resolution.

i. Project Chief Safety and Mission Assurance Officer

The Project Chief Safety and Mission Assurance Officers will be the single point of contact for program/project matters involving SMA technical authority. Talent, skills, previous experience, and development assignment opportunities are all factored into the selection of a CSMAO. The mastery of the technical authority process is incumbent in the qualifications required by a CSMAO. The engineer assigned to such a position shall be fluent in the NPR 7120.5, NPR 7123.1, NPR 8700.3 and in the principles of issue/ dispute resolution.

The CSMAO will execute the technical duties typically expected from the primary SMA authority assigned to a project. Briefly, these include duties of insight, oversight, identification and development of compliance activities and delegation of responsibility for task execution. Also included is the signature authority for plans for System Requirements Review, Preliminary Design Review, Critical Design Review, and Flight Readiness Review. Development of teams and tasks assignments to address SMA will be the responsibility of the CSMAO, PDE and PM.

VI. DESCRIPTION OF FUNDING

All GRC personnel designated as a Technical Authority will be funded independently of all programs and projects. The following table identifies the Full Time Equivalent (FTE) Position profile for the GRC CM&O account for engineering technical authority. The associated budgets

will be based on requirements established in the annual Planning, Programming, Budgeting, and Execution (PPBE) process and include all the funding necessary to fully support the TA function.

	FY10	FY11	FY12	FY13	FY14	FY15
Engineering Total	79.0	79.0	79.0	79.0	79.0	79.0
SMA Total	10.0	10.0	10.0	10.0	10.0	10.0

All personnel in the Engineering Directorate and SMA Directorate at the branch level and above, as well as all other known personnel expected to receive appointments as a Technical Authority, are covered under this funding authority.

VII. TRAINING

The Center Chief Engineer and the Director SMA, respectively will be responsible for needed training and development activities to assure the successful implementation of the GRC approach to technical authority. All appropriate and useful resources from the Office of Human Resources and Workforce Planning, the Organization Development and Training Office, and the efforts of the Engineering Training and SMA training committees will be utilized to assure efficiency for this process.

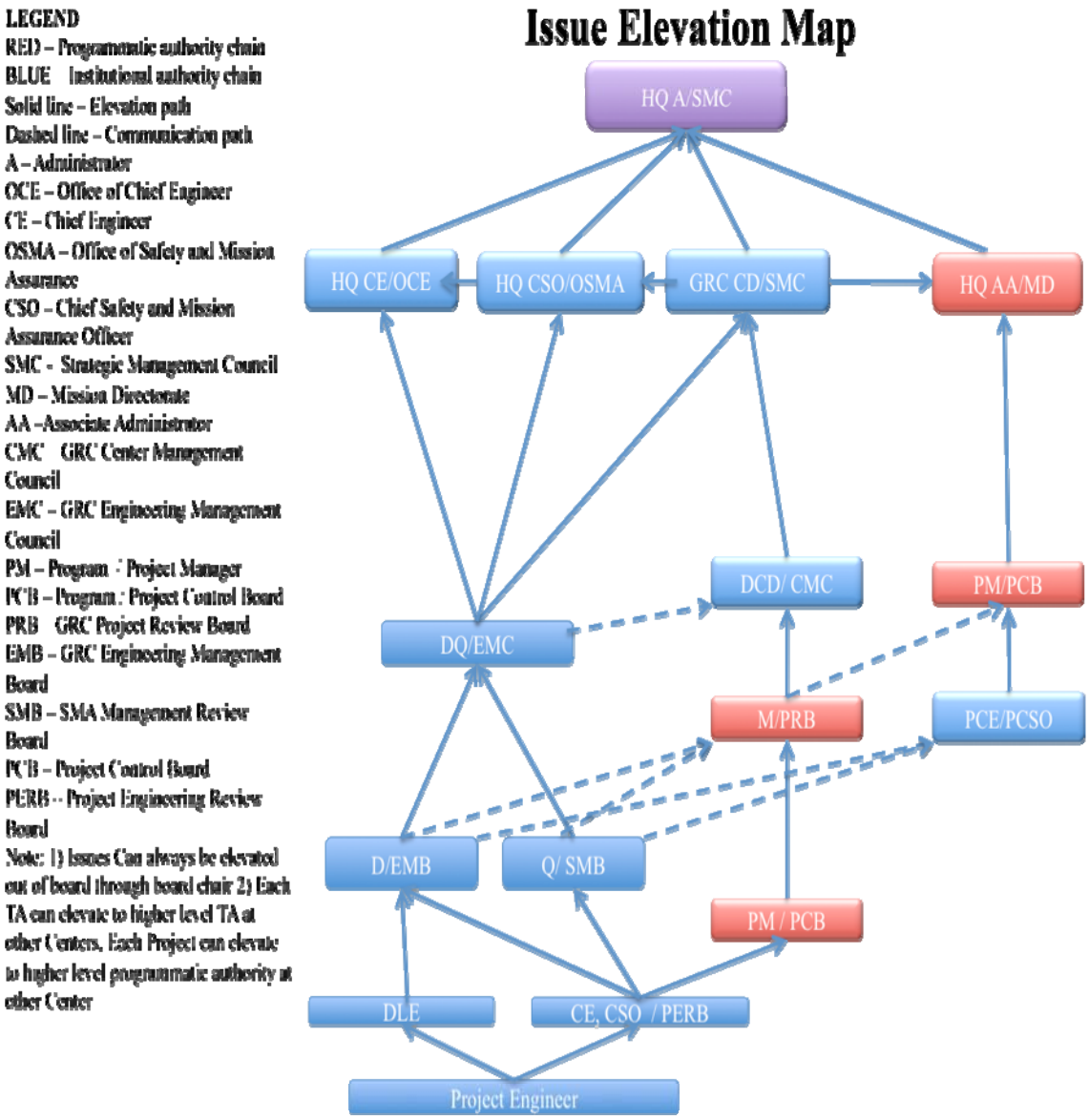

Figure 1: Issue Elevation Paths

Governance Model & Tech Authority

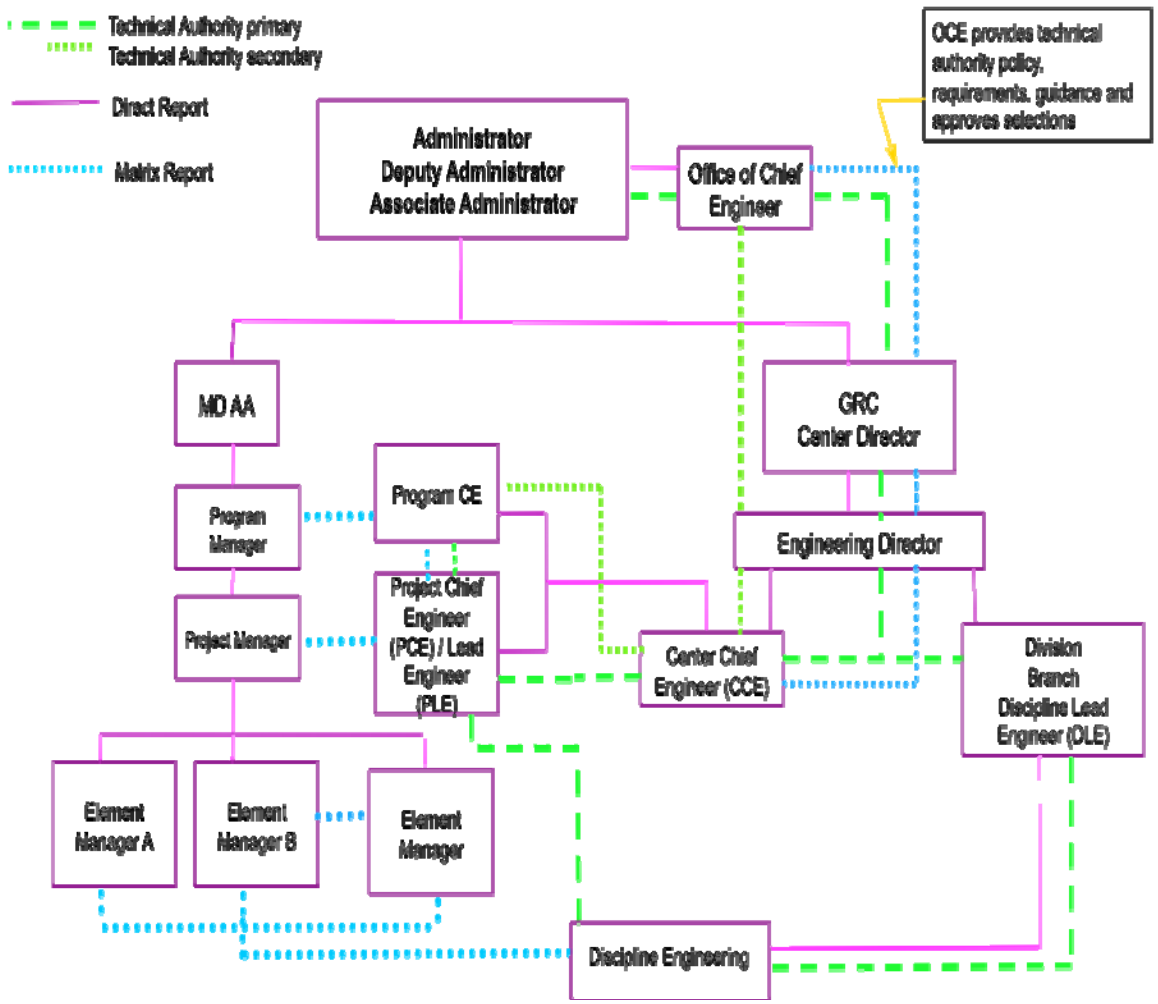

Figure 2. Flow of Engineering Technical Authority from the NASA Administrator

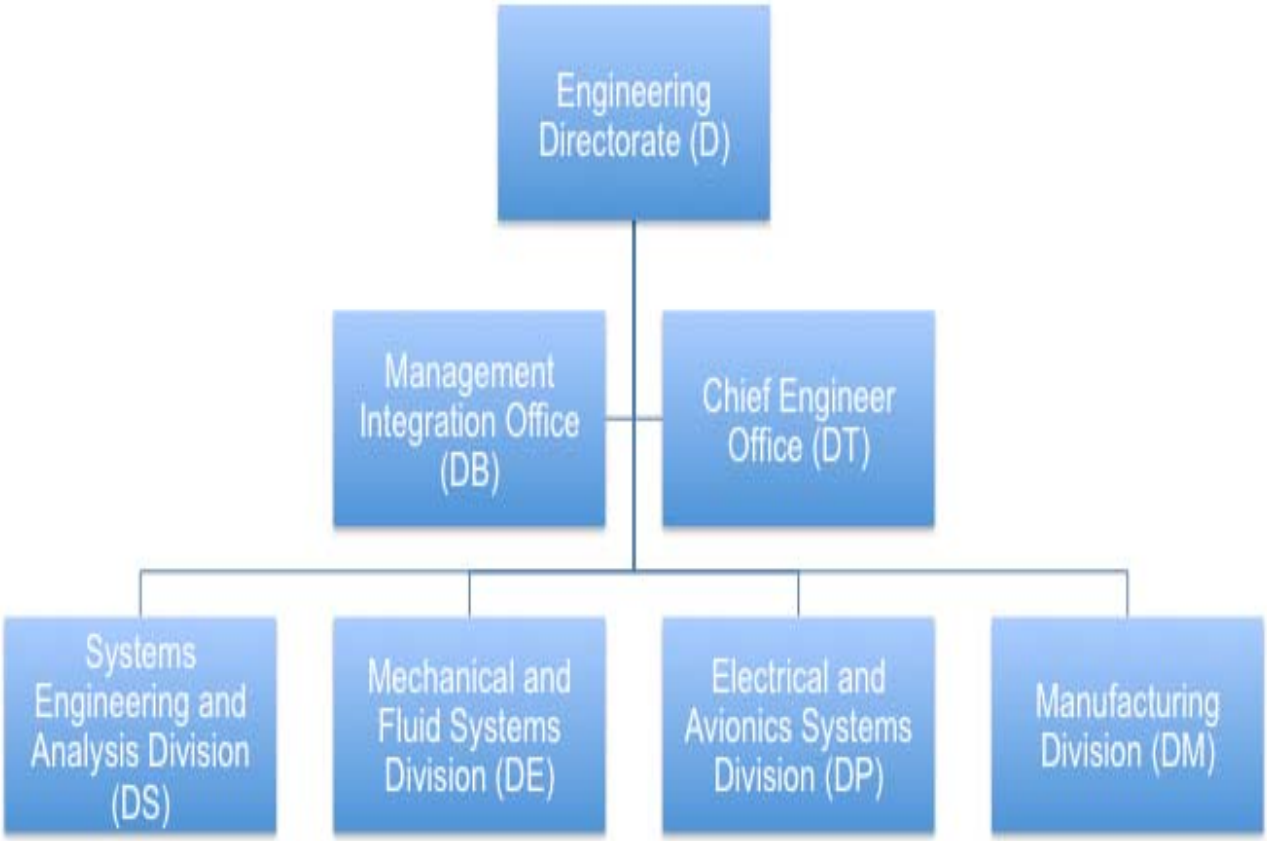

Figure 3. Engineering Directorate Organization

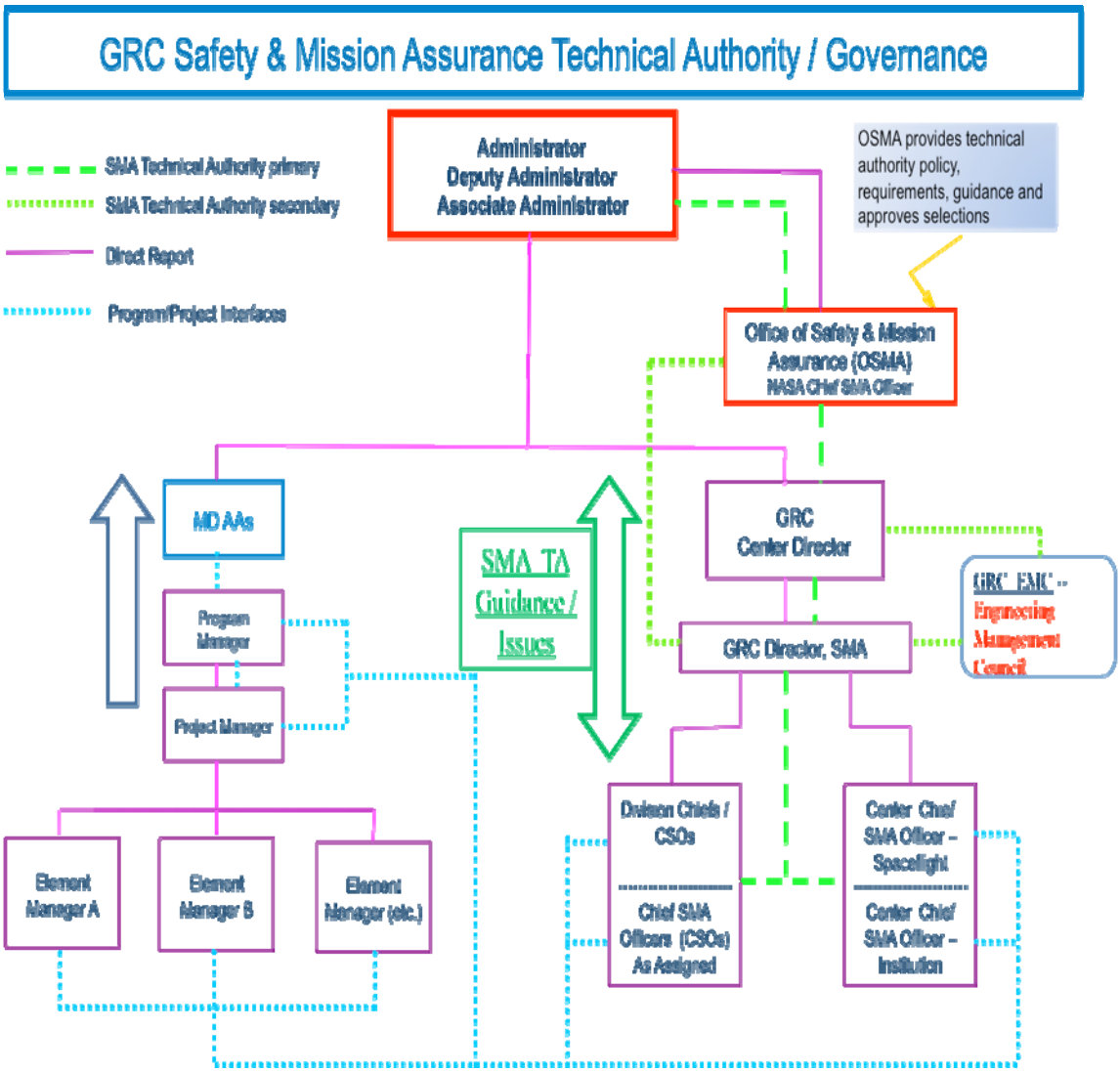

Figure 4. Flow of Safety and Mission Assurance Technical Authority from the NASA Administrator

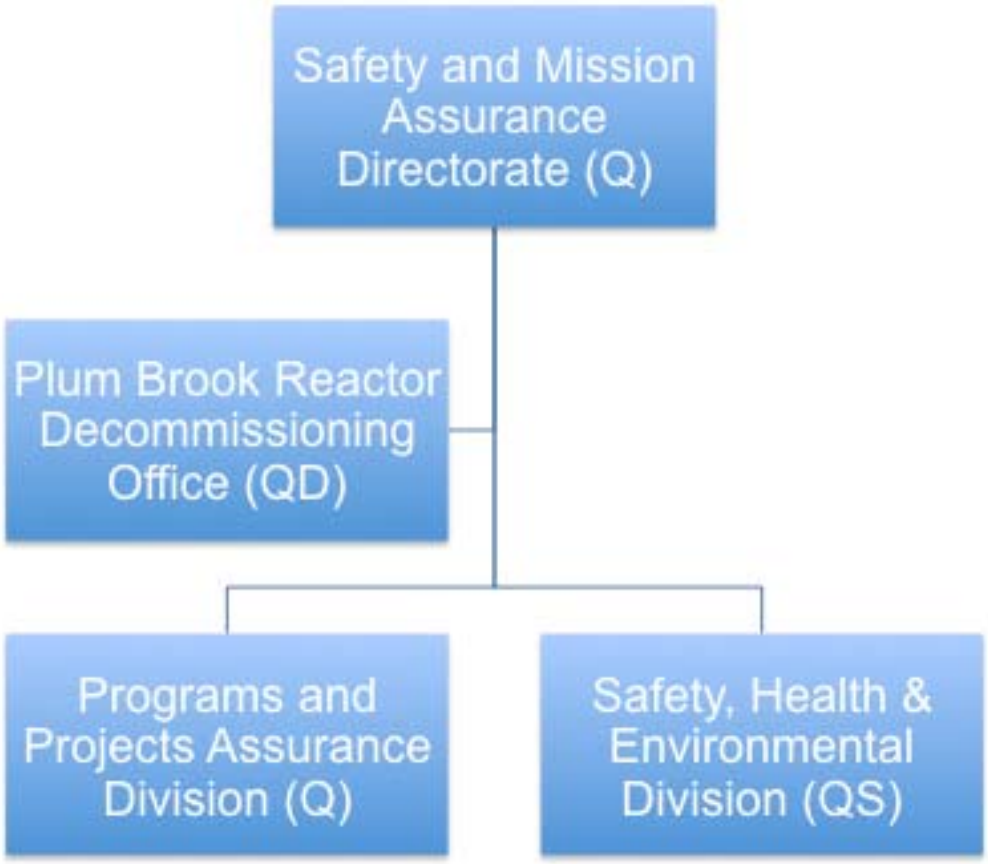

Figure 5. Safety and Mission Assurance Directorate Organization

Appendix 1: TEMPLATE FOR DOCUMENTING ISSUES, DISSENTING VIEWS, AND PERTINENT FACTS

INVOCATION OF ISSUE/ DISSENTING VIEW PROCESS

1. STATEMENT OF TECHNICAL ISSUE:
   a. Brief description of technical (design choice, requirement, and standard)
   b. Presentation of competing views
   c. Discussion of different positions

2. PRESENTATION OF IMPACTS TO THE PROJECT OBJECTIVES
   a. Achievement of vs. shortfall from project technical objective
   b. Need or potential for change to implemented standards and/or requirements set
   c. Impact to the budget

3. PROPOSED WAIVER, if applicable

4. INITIATOR

5. PROJECT SYSTEMS ENGINEER (APPLICABLE TECHNICAL AUTHORITY)

6. PROJECT MANAGER

7. STATEMENT OF RESOLUTION

8. IMPLEMENTATION INSTRUCTIONS

9. DOCUMENTATION INSTRUCTIONS

10. EFFECTIVE DATE

Appendix 2: WAIVERS

A waiver is a documented agreement intentionally releasing a program or project from meeting a requirement. There are three sources of requirements which are: 1) Mission and technical requirements originating at Headquarters or higher and decomposed through Mission Directorates to Programs and Projects, 2) Institutional technical requirements originating with a Center Technical Authority and 3) Derived technical requirements established by a Program or Project Technical Authority.

Evaluation and disposition of waivers to technical requirements is a key piece of Technical Authority. To effectively support and avoid duplication, the programs and projects' chief engineers, lead discipline engineers and the discipline engineers will execute the TA by working within the existing processes and board structures in the programs and projects. In general, the waiver process should be governed by three Principles:

1. The Discipline Engineers are responsible for generating the waivers and coordinating with the Prog/Proj CEs and Lead Discipline Engineers when applicable. The waiver is then sent to the Program/Project Managers (or designee), the Director of Engineering (or designee) and the Director of SMA (or designee) for concurrence. The Center Director, or HQ, if required, or his/hers designee, as the Technical Authority, is the approving authority for the waiver.

2. The organizations that agreed with the establishment of a requirement originally must agree to the waiver to the requirement.

3. To provide visibility and function as a check and balance, the next higher level of Technical and Programmatic Authority must be informed in a timely manner of each waiver request and must approve subsequent actions.

If the waiver is not granted the project manager may accept the decision or invoke the GRC Issue/ Dissenting View Process for adjudication and resolution. To provide visibility and function as a check and balance, the next higher levels of Technical and Programmatic Authority will be informed in a timely manner of waiver request and the subsequent action taken.

Appendix 3: ISSUE/DISSENTING OPINIONS RESOLUTION

The NASA life cycle (ref. c) consists of the basic formulation and implementation phases. These are further subdivided into the project life cycle phases: three phases (Concept Studies, Concept Development, and Preliminary Design) for the former, and into four phases (Final Design & Fabrication, Assembly & Test, Operations & Sustainment, and Closeout) for the later. Normally, usual management and engineering process activities will be conducted to achieve progress towards the project's objectives. These include the normal engineering activities of investigations, discoveries, and appropriate design/trades/decisions.

In the course of these efforts, disagreements over the correct technical approach, requirements interpretation, or standards application will arise. It is at this stage (assuming normal trades, decision trees, and/or logical approaches have been tried, but with no success at reaching agreement) that the process for issue resolution by the Technical Authority is invoked.

The process for handling dissenting opinions is based on the personal responsibility, which each individual has, to adhere to the Agency's shared core values of safety, teamwork, integrity, and mission success. In exercising this personal responsibility, individuals are required and encouraged to bring dissenting opinions to the appropriate authority (e.g., the Program or Project Manager, anyone in the Technical Authority chain) in an open and timely manner, and without fear of retribution. Dissenting opinions shall be solicited, documented, reported, and dispositioned appropriately.

As soon as an individual or team reaches the conclusion that normal project and engineering activities will be insufficient to resolve a technical matter, a written request is to be made to the PCE to invoke the dissenting process. A sample template describing what is to be included is shown in Appendix 1. All competing or dissenting views are to be presented to the appropriate Technical Authority in a timely manner. The presentation material must include all relevant facts and positions, the technical rationale for the differing positions, and the recommendations (or preferred decisions) from each competing view. Concurrent with the presentation of these materials, management officials in the technical authority, project/program, and SMA chains will be informed of the invocation of the dissenting process, along with a basic summary of the issue and the competing views for resolution.

In the technical authority process, the PCE has the responsibility to develop an informed position on the issue and to submit a decision regarding the issue. If these are not appealed, the project will immediately implement the decisions of the Technical Authority. If the project manager continues to disagree with the decision of the PCE, personnel in the program/project management chain may formally request the decision be elevated to the next higher level of technical authority. The PCE Technical Authority must automatically raise the decision to the Center Chief Engineer, within the CEO. The project chief engineer will utilize the services of the EMC, chaired by the Director of Engineering (or his/her designee), to identify the legitimacy of issues, to evaluate the options associated with the issues, and ultimately to arrive at a recommendation for resolution of the technical issue. The decision will be made based on the technical facts of the issue.

In summary, whenever the dissenting process is invoked for an issue and an impasse continues between decision choices, or when there continues a disagreement between the project manager and the PCE after a finding is issued, the issue may be elevated up to the next decision level. This process of elevation is similar for both chains and is to be successively applied. For the project manager, this path flows up to the program manager, to the Mission Director, to the Administrator. For the PCE, the path is up through the Center Chief Engineer/ Director of Engineering, to the Center Director, to the Office of the Chief Engineer at NASA HQ, to the Administrator.

In all instances, the Technical Authority's decision/action on the issue is to be documented and provided to all parties (i.e., all dissenters and their immediate managers). The decision is to be implemented in the project, and the resulting documentation made an official part of the project record.