Architecture and Design: A description of the mission elements, their interfaces, their logical and physical layout, and the analysis of the design to determine expected performance and margins, including System Design Synthesis, System Design Analysis, and System Design Validation products.

Baseline: Configuration of a product, at a specific point in time, which serves as a basis for defining change, for conducting verifications, and for other management activities [EIA-649].

Baseline Length: The distance between two points, such as two VLBI stations.

Baseline Requirements: The mission performance requirements necessary to achieve the full science objectives of the mission. [NPR 7120.5E]

Basis of Estimate: The documentation of the ground rules, assumptions, and drivers used in developing the cost and schedule estimates, including applicable model inputs, rationale or justification for analogies, and details supporting cost and schedule estimates [NPR 7120.5E].

Collocation: Two or more geodetic techniques or systems occupying simultaneously or subsequently very close locations.

Collocation analysis: The process of comparing ranging data to the 1-millimeter (mm) level from two or more satellites laser ranging systems in close proximity (<600 meters, preferably <60 meters) by quasi-simultaneously ranging to common retroreflector equipped satellite. Close proximity allows for a direct range to range comparison between the two systems without the need for an orbit and removes any ambiguities due to differences in atmosphere. Collocation ranging includes all satellites that the systems are capable of. Both systems range to the same satellites at the same time. A full collocation normally takes one or more months to ensure enough data is collected to adequately determine performance. https://ilrs.cddis.eosdis.nasa.gov/network/system_performance/co-location_history.html

Command: A data packet sent to a station/site that requests the station/site perform a function.

Configuration Management (CM): A technical and management process for establishing and maintaining consistency of a product's functional and physical attributes with its requirements, design and operational information throughout its life [EIA-649].

Continuous Risk Management: A systematic and iterative process that efficiently identifies, analyzes, plans, tracks, controls, communicates, and documents risks associated with implementation of designs, plans, and processes.

Coordinated Universal Time (UTC): A modern continuation of Greenwich Mean Time, the standard "clock time."

Core Site: Geodetic site with all three next-generation geodetic stations: VLBI, SLR, and GNSS tied together with VTS. DORIS desirable.

Crustal Dynamics Data Information System (CDDIS): A NASA system for space geodetic data archiving and distribution.

Data Operations Center (DOC): The operational method for legacy SLR to manage end-to-end the cycle of SLR data from generation of satellite predictions, generation of tracking schedules, dissemination to the SLR systems in the field, receipt of science data from the systems, performing data quality checks, packaging the science data and delivery to the Data Information Services (DIS) at NASA's Crustal Dynamics Data Information System (CDDIS) and to the European Data Center (EDC).

Datum: A set of constants specifying the coordinate system used for geodetic control (i.e., for calculating coordinates of points on the Earth).

De-confliction between Techniques: Avoid/manage any interference between two techniques that could degrade performance and/or damage one or the other's equipment. A specific example is between the SLR radar and the VLBI detector.

Designated Governing Authority:The management entity above the program, project, or activity level with technical oversight responsibility.

Development Risk: Risk of not delivering a quality product on time and within cost.
Deviation: Specific authorization releasing the project from meeting a requirement prior to going into system verification.

Dissenting Opinion: A disagreement with a decision or action that is based on a sound rationale (not on unyielding opposition) that an individual judges is of sufficient importance that it warrants a specific review and decision by higher level management, and the individual specifically requests that the dissent be recorded and resolved by the Dissenting Opinion process.

Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS): A French geodetic technique in which transmitters on the ground communicate with receivers on satellites to provide precise orbit determination.

Driving Requirement: A requirement that is identified by a lower –level element as impacting the design or implementation of that element in a major way. Driving requirements are usually associated with performance, cost, mass and schedule, and effectively define the architecture of the system or element(s). Driving requirements may involve the type of technology, type of equipment required, number of units, or software functionality. (See also "Key Requirement.")

Earth Orientation Parameters (EOP): Describe the irregularities of the Earth's rotation. Technically, they are the parameters that provide the rotation of the ITRF to the ICRF as a function of time. The term “Earth Orientation” refers to the orientation of the Earth in three-dimensional space. It is usually measured with respect to coordinate axes defined on the Earth using five angles: two angles called the polar motion coordinates which identify the direction of the Earth's rotation axis within the Earth (polar motion coordinates measure the position of the Earth's instantaneous pole of rotation in a reference frame which is defined by the adopted locations of terrestrial observatories); an angle describing the rotational motion of the Earth (called UT1; this coordinate measures the angle through which the Earth has turned in a given period of time); and two angles which characterize the direction of the Earth's rotation axis in space. With these coordinates, the orientation of the Earth in three-dimensional space is fully described.

Earth Rotation: The rotation of the Earth on its rotation axis. In geodesy, Earth rotation refers specially to the perturbation of the rotation rate, which leads to variations in the length of day.

Fundamental Geodetic Site: Equivalent name for a Core Site.

Geodesy: The science of accurately measuring and understanding the Earth's geometric shape, its orientation in space, its gravity field, and changes in these properties over time.

Geodetic Site: Collection of one or more space geodesy stations and common infrastructure at one physical location tied together with a vector tie system.

Geoid: The equipotential (level) surface of the Earth's gravity field, which is the best approximation to global mean sea level extended over the land. The geoid undulates up and down with local variations in the mass and density of the Earth.

Global Navigational Satellite System (GNSS): General term for positioning systems like GPS, GLONASS, Galileo, and COMPASS.

Global Space Geodesy Network: Worldwide collection of stations that are members of the international services (ILRS, IVS, IGS, IDS).

Hybrid Surveillance Approach: A hybrid surveillance approach that combines elements of insight and oversight will be instituted at the contractor's facility to ensure a high level of confidence exists regarding the contractor's ability to identify, manage, and control programmatic risks, including when new technology is acquired or unproven processes are employed by a contractor, their subcontractors, suppliers, or vendors. In this situation, oversight surveillance is used until the Government is satisfied that the contractor, subcontractor, or supplier has all critical processes under control. The oversight activities usually impose Government Mandatory Inspection Points in-series with the contractor's development and manufacturing processes. Only after the contractor's demonstration of sufficient risk mitigation capabilities will NASA consider transitioning to insight activities that rely predominantly on internal contractor data. The transition period from oversight to insight activities would be accomplished gradually, depending on contractor performance.

Implementation: The execution of approved plans for the development and operation of the program/project, and the use of control systems to ensure performance to approved plans and continued alignment with the Agency's strategic needs, goals, and objectives [NPR 7120.5].

Independent Review Board (IRB): A review panel established by a group of competent individuals who have specific expertise but not associated with a project to objectively assess the adequacy of a specific project or subproject design at specific points in the project's lifecycle. Then provide feedback to the project and project management of the success or issues with the project post-review.

Insight (Surveillance Strategy): Insight is an assurance process that uses performance requirements and performance metrics to ensure process capability, product quality, and end-item effectiveness. Insight relies on gathering a set of product or process data that provides adequate visibility into the integrity of the product or process. The data may be acquired from contractor records, usually in a non-intrusive parallel method.

Interface Control: The process of identifying, recording, and managing product attributes at the common boundary between two or more products provided by one or more organizations [NASA-STD-0005].

Interface Control Document (ICD): A formal specification of product attributes at the common boundary between two or more products provided by one or more organizations. [NASA-STD-0005].

Integrated Baseline Review (IBR): A joint assessment by the offeror/contractor and the Government to verify the technical content and the realism of the related performance budgets, resources, and schedules. It should provide a mutual understanding of the inherent risks in offerors'/contractors' performance plans and the underlying management control systems, and it should formulate a plan to handle these risks.

Integrated Master Schedule (IMS): A logic network-based schedule that reflects the total project scope of work, traceable to the WBS, as discrete and measurable tasks/milestones and supporting elements that are time phased through the use of valid durations based on available or projected resources and well-defined interdependencies. [NPR 7120.5E].

International Atomic Time (TAI): A high-precision measurement of time as measured by atomic clocks. From the French, Temps Atomique International.

International Celestial Reference Frame (ICRF): Consists of a set of precise coordinates of compact extra-galactic radio sources observed by Very Long Baseline Interferometry (VLBI) that realizes the International Celestial Reference System (ICRS).

International Celestial Reference System (ICRS): Based on a kinematical definition, yielding fixed axis directions with respect to the distant matter of the universe. The system materialized by a celestial reference frame consisting of the precise coordinates of extragalactic objects, mostly quasars, BL Lacertae (BL Lac) sources and a few active galactic nuclei (AGNs), on the grounds that these sources are that far away that their expected proper motions should be negligibly small. The ICRS can be connected to the International Terrestrial Reference System (ITRS) by use of the IERS Earth Orientation Parameters (EOP).

International DORIS Service (IDS): An international service under the IAG for coordinating analysis and distribution of DORIS data and data products.

International Earth Rotation and Reference Systems Service (IERS): An international service for the astronomical, geodetic and geophysical communities that provides data and standards related to Earth rotation and reference frames.

International GNSS Service (IGS): An international service under the IAG for coordinating acquisition, analysis and distribution of GNSS data and data products.

International Laser Ranging Service (ILRS): A set of points with their 3-dimensional Cartesian coordinates and velocities which realize an ideal reference system, the International Terrestrial Reference System (ITRS), as defined by the IUGG resolution No. 2 adopted in Vienna, 1991.

International Terrestrial Reference System (ITRS): Constitutes a set of prescriptions and conventions together with the modeling required to define origin, scale, orientation and time evolution of a Conventional Terrestrial Reference System (CTRS). The ITRS is an ideal reference system, as defined by the IUGG resolution No. 2 adopted in Vienna, 1991. The system is realized by the International Terrestrial Reference Frame (ITRF) based upon estimated coordinates and velocities of a set of stations observed by VLBI, LLR, GPS, SLR, and DORIS. The ITRS can be connected to the International Celestial Reference System (ICRS) by use of the IERS Earth Orientation Parameters (EOP).

International VLBI Service for Geodesy and Astrometry (IVS): An international service under the IAG for coordinating acquisition, analysis and distribution of VLBI data and data products.

Key Decision Point (KDP): The event at which it is determined that the program or project is ready to progress to the next phase of the lifecycle (or to the next KDP).

Key Requirement: A requirement that is allocated by an upper-level element for items that are considered vital. Key requirements may pertain to public safety or planetary protection, and are usually related science goals or mission-critical parameters. Key requirements are considered essential to build a robust system. (See also "Driving Requirement.")

Leap second: A one-second adjustment to international atomic time (TAI) (to produce Coordinated Universal Time (UTC)) to maintain its synchronization with the solar day. This occasional adjustment is necessary because the rotation of the Earth is constantly undergoing a non-uniform deceleration primarily caused by the braking action of the tides. A leap second can be either positive or negative depending on the Earth's rotation. However, since their introduction in 1972, all leap seconds have been positive. This reflects the general slowing of the Earth's rotation.

Length of Day (LOD): The exact amount of time (nominally 24 hours) it takes the Earth to rotate on its rotation axis; due to motions of mass on and within the Earth, the length of day continuously varies.

Level 1 Requirement: The fundamental and basic set of requirements levied on the Program by the Agency.

Level 2 Requirement: The set of functional and performance requirements that define the Program as a "system," and the allocation of those requirements to the various projects of which the Program is composed.

Level 3 Requirement: The set of functional and performance requirements that define the Project as a "system," and the allocation of those requirements to the various functional elements that the Project must fulfill. For the SGP, the Level 3 Requirement set is composed of the system level requirements for the techniques, stations, and sites.

Life Cycle: A generic term covering all phases of acquisition, operation, and logistics support of an item, beginning with the concept definition and continuing through disposal of the item [NASA-STD-0005].

Life Cycle Cost (LCC): The total cost of acquisition and ownership of that system over its life cycle. It includes the cost of development, acquisition, support, and where applicable, disposal [NASA-STD-0005].

Legacy Station: Stations using older technology that do not necessarily meet the current SGP requirements and/or the guidelines set by the geodetic services. Non-broadband VLBI, MOBLAS, TLRS, and GPS stations.

Logistics: The management, engineering activities, and analysis associated with design requirements definition, material procurement and distribution, maintenance, supply replacement, transportation, and disposal that are identified by space flight and ground systems supportability objectives.

Measurement Concept: A concept that defines what measurements must be taken to achieve the Science Objectives. Includes characteristics of measurements, such as, spectral band, resolution, sample rate, duration of observation, type of observation, vantage, and others. This includes New Technology Validation Concepts.

Message Bus: Physical layer used to transfer information.

Metric: A measurement taken over a period of time that communicates vital information about the status or performance of a system, process, or activity. A metric should drive appropriate action.

Mission: A major activity required to accomplish an Agency goal or to effectively pursue a scientific, technological, or engineering opportunity directly related to an Agency goal. Mission needs are independent of any particular system or technological solution.

Mission Design Requirements: The high-level requirements needed to achieve the objectives of the Project. These include operational need date, anticipated system life, and other strategic requirements that drive the Mission Architecture.

NASA Space Geodesy Network (NSGN): The collection of NASA and NASA partner stations.

Next Generation Station: Stations using the latest and/or upcoming technology and following the guidelines set by the geodetic services. These include VGOS/VLBI2010, SGSLR/NGSLR, and multi-constellation GNSS stations.

Nutation: Small nodding oscillations of the Earth's rotation axis in space.

Objectives: A set of goals and constraints that define the purpose of the mission and the programmatic boundaries and provide a basis for the Mission Design requirements and mission success criteria.

Observatory: Collection of co-located space geodesy stations, tied together with a vector tie system, and common infrastructure at one site.

Operations Concept: A concept that defines how the mission will be verified, implemented at the SGP sites, commissioned, operated, and transitioned to operations. Defines how the design is used to meet the requirements.

Oversight (Surveillance Strategy): Oversight is an assurance process that uses Government-imposed product specification and process controls, such as military (MIL) specifications, MIL standards, and mandatory inspections, to direct the development and production of the product. Oversight is intrusive in that it requires gathering contractor product or process data through on-site, in-series involvement in the process. Oversight entails very detailed monitoring of the process itself. Oversight also entails a measure of in-line involvement in an activity, principally through inspection including Mandatory Inspection Points, with review and approval authority implicit to the degree necessary to assure that a process's or product's key characteristics are stable and under control.

Partner Site: Geodetic site owned or operated by another organization where NASA regularly commits resources by providing one or more NASA-owned stations and/or NASA regularly supports the maintenance and/or operations of one or more stations at that site.

Partner Station: A NASA-owned or supported geodetic station at a NASA Partner Site.

Plotting: Graphical display of data.

Polar motion: The motion of the rotation axis of the Earth relative to the crust has three major components. A free oscillation with period about 435 days (Chandler wobble) and an annual oscillation forced by the seasonal displacement of air and water masses, beating with each other, give the characteristic pulsating shape of the motion. The mean pole has an irregular drift in the direction to 80 deg. West.

Precession: The motion of the Earth's axis along a circle in the sky taking ~26,000 years.

Precise Orbit Determination (POD): The precise determination of the orbital position of a satellite by geodetic methods.

Project: A specific investment identified in a Program Plan having defined requirements, a life-cycle cost, a beginning, and an end. A project also has a management structure and may have interfaces to other projects, agencies, and international partners. A project yields new or revised products that directly address NASA's strategic goals [NPR 7120.5E].

Reference System: The theories, models, and physical constants underlying a reference frame.

Requirement: A statement of a function to be performed, a performance level to be achieved, or an interface to be met. Requirements are indicated by the word "shall".

Requirements Document: An organized hierarchy of requirements that provides a validation and verification basis for a system or system element.

Risk:The combination of the probability that a program or project will experience an undesired event and the consequences, impact, or severity of the undesired event, were it to occur. The undesired event may come from technical or programmatic sources (e.g., a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological objective, or success criterion). Both the probability and consequences may have associated uncertainties.

Risk Assessment/Analysis: An evaluation of a risk item that determines (1) what can go wrong, (2) how likely is it to occur, (3) what the consequences are, and (4) what are the uncertainties associated with the likelihood and consequences.

Risk Reduction: The activities performed to reduce the likelihood of a risk occurring, the consequence should the risk occur, or both.

Resource Tracking: The activity of tracking and maintaining technical resource allocations, estimates, and margins for system elements.

Safety: Freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. [NPR 7120.5E]

Safety Risk: Risk of injury to personnel, facilities or hardware.

Security: Protection of people, property, and information assets owned by NASA that covers physical assets, personnel, IT, communications, and operations. [NPR 7120.5E]

Site: A physical location of a geodetic station or co-located stations.

Stakeholder: An individual or organizational customer having an interest (or stake) in the outcome or deliverable of a program or project. [NPR 7120.5E]

Software: Refers to any software, firmware, scripts, databases, configuration files, data files, or other software code within the SG system

Software Framework: Operating System, Programming language, data transport (middleware), etc.

Space Geodesy Network Operations Center (SGNOC): An architectural construct that enables efficient and cost-effective monitoring and operations of all NASA Space Geodesy Sites, Stations, and equipment within the NSGN (including legacy SLR and VLBI stations as feasible), as well as the potential for monitoring other international partner stations, sites and/or equipment. Comprised of the operational facilities, software tools, activities, and processes for the NSGN to manage the end-to-end the cycle of space geodesy data collection, including: generation and dissemination of satellite predictions, generation and dissemination of observation schedules, remote operations (command and control) and monitoring of the NSGN Station, Sites and equipment, receipt of science and monitoring data from the systems, performing data quality checks, packaging the science data and delivery to the Crustal Dynamics Data Information System (CDDIS) and European Data Center (EDC).

Specification: A document that prescribes, in a complete, precise, verifiable manner, the requirements, design, behavior, or characteristics of a system or system element. A specification provides a *verification basis* for a system or system element.

Station: One implementation of the ground component of a geodetic technique.

Surveillance Strategies: The approach to surveillance of the Contractor is based on a combination of "Insight," "Oversight," and "Hybrid" techniques.

Sustaining Engineering: Technical tasks (engineering and logistics investigations and analyses) that ensure continued operation and maintenance of a system with managed (i.e., known) risk. Sustaining Engineering involves the identification, review, assessment, and resolution of deficiencies throughout a ground system and its associated infrastructure life cycle. Sustaining Engineering both returns a system to its baselined configuration and capability and identifies opportunities for performance and capability enhancements. It includes the measurement, identification and verification of system technical and supportability deficiencies, associated root cause analyses, evaluation of the potential for deficiency correction and the development of a range of corrective action options.

System: The combination of elements that function together to produce the capability required to meet a need. The elements include all hardware, software, equipment, facilities, personnel, processes, and procedures needed for this purpose.

System of Interest: The identified part of the system hierarchy, whether a part, assembly, or subsystem, that is assigned to the engineering team.

Systems Engineering: A disciplined approach for the definition, implementation, integration, and operation of a system (product or service). The emphasis is on achieving stakeholder functional, physical, and operational performance requirements in the intended use environments over its planned life within cost and schedule constraints. Systems engineering includes the engineering processes and technical management processes that consider the interface relationships across all elements of the system, other systems, or as a part of a larger system. [NPR 7120.5E]

Systems Engineering Management Plan (SEMP): An implementation plan for the performance of systems engineering functions and the development of systems engineering products. This plan identifies what, when, where, by whom, and how the functions are performed. It specifies the schedule for the development, and the resources required.

Technical Authority: The key individual accountable and responsible for the technical integrity of the mission.

Technique: End-to-end process that includes all components/segments (ground, space, data, etc.) of a geodetic measurement method (i.e., SLR, VLBI, etc.).

Telemetry: Information (data) transferred from/to a site/station.

Threshold Requirements: The mission performance requirements necessary to achieve the minimum science acceptable for the investment. [NPR 7120.5E]

Trending: Analysis and plotting of logged data to look at systematic behavior over time.

Universal time (UT1): The time of the Earth clock, which performs one revolution in about 24h. It is practically proportional to the sidereal time. The excess revolution time is called length of day (LOD).

Validation: The process of showing proof that the product accomplishes the intended purpose based on stakeholder expectations. May be determined by a combination of test, analysis, demonstration, and inspection. (Answers the question, "Am I building the right product?") [NPR 7120.5E]

Validation Basis: A set of requirements that provides the success criteria for a system or system element. The Validation provides proof that the product accomplishes the intended purpose based on requirements. May be determined by a combination of test, analysis, demonstration, and inspection.

Vector Tie System (VTS): A local reference frame tie across multiple techniques, used to improve the TRF combination, and monitoring of Site stability over time. This is accomplished by monitoring a fiducial point on a technique with knowledge of that point to its measurement reference location, such as the invariant point on the SLR or VLBI system and through monitoring at regular intervals the locations for all techniques at a particular site those reference points can determine if local ties are stable.

Verification: Proof of compliance with requirements. Verification may be determined by a combination of test, analysis, demonstration, and inspection. (Answers the question, "Did I build the product right?") [NPR 7120.5E]

Verification Basis: A set of specifications that define details of implementation, function, and performance to be verified. The Verification Basis provides proof of compliance with design solution specifications and descriptive documents, and may be determined by a combination of test, analysis, demonstration, and inspection.

Waiver: Specific authorization to accept a designated item that failed to meet a requirement during system verification yet is considered acceptable for use "as-is."

Work Breakdown Structure (WBS):A product-oriented hierarchical division of the hardware, software, services, and data required to produce the program/project's end product(s), structured according to the way the work will be performed, and reflective of the

way in which program/project costs, schedule, technical and risk data are to be accumulated, summarized, and reported. [NPR 7120.5E]