QPS Fabrication Project
Work Breakdown Structure (WBS) Dictionary
Diagnostics (WBS 3)

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QPS WBS Dictionary
Diagnostics (WBS 3)

WBS Element: 3	WBS Level: 2
WBS Title:	**Diagnostics**
Description:	The diagnostic systems provide the detailed measurements of the plasma parameters that are critical to the research goals of QPS. Each diagnostic system must be designed to satisfy specific measurement requirements that are derived from the research program. These requirements can be described in terms of the range of the plasma parameter being measured, the desired accuracy, and the spatial and temporal resolution required to permit the experimental investigation of the various research topics. These systems typically include state-of-the-art instrumentation detecting light or particles from the plasma or plasma facing components, and the supporting interface hardware that provides the required views. Overall QPS diagnostic requirements for the complete program have been identified and are discussed (including access requirements and a preliminary port assignment) in the WBS 3 section of the QPS Conceptual Design Report. The set of diagnostics that are part of the QPS Fabrication Project are only those needed to verify that the core device has met its engineering goals and is ready for physics operations. WBS 3 includes this set of basic diagnostic system components. These include sensors, collection systems and associated support structures, sensor cables, and signal conditioning hardware and racks. Included in the Fabrication Project are all the engineering and physics design efforts starting with the preliminary design phase (Title I) and ending with completion of the Fabrication Project, all the necessary Research and Development (R&D) to support the design effort, all component fabrication, assembly, and installation activities, and all system level commissioning and testing, including diagnostic alignments and calibrations through the CD-4 project completion milestone. Diagnostic Systems (WBS 3) includes: • Baseline Diagnostics (WBS 31); • Phase 2 Diagnostics, Upgrades (WBS 32); • Phase 3 Diagnostics, Collaborators/Optional (WBS 33); The diagnostics required for the QPS program (as opposed to the fabrication project) have been identified in the QPS Conceptual design report and include all elements in WBS 3. These diagnostics have been developed based on an assessment of the required measurements for particular phases of the QPS experimental program. The necessary engineering and analysis to ensure that the QPS facility is compatible with those diagnostics, as well as sufficiently flexible to accommodate a range of new diagnostics whose need may be identified in the QPS experimental program, are part of the WBS elements for the affected components. Only those diagnostics in WBS 31 are presented at the WBS 4-level detail.

QPS WBS Dictionary
Diagnostics (WBS 3)

WBS Element: 31	WBS Level: 3
WBS Title:	**Baseline Diagnostics**
Description:	Diagnostics required for measurements and analysis required to determine that QPS has the necessary engineering and physics capability required to carry out the physics program.

WBS Element: 311	WBS Level: 4
WBS Title:	**Vacuum and Thermal Diagnostics**
Description:	This WBS element consists of: • Diagnostics required for evaluation of vacuum quality in QPS. This includes residual gas analysis, nude ion gages, baratrons, and a Penning gauge. • Thermocouple systems to measure vacuum vessel and limiter temperatures.

WBS Element: 312	WBS Level: 4
WBS Title:	**Magnetic Diagnostics**
Description:	The magnetic sensors for the fabrication project include two Rogowski coils for measuring plasma current.

WBS Element: 313	WBS Level: 4
WBS Title:	**Density Diagnostics**
Description:	This WBS element consists of a two-mm, single-chord, microwave interferometer for measuring line-averaged electron densities.

WBS Element: 314	WBS Level: 4
WBS Title:	**Radiation Diagnostics and Suppression**
Description:	This WBS element consists of radiation monitors to indicate possible runaway electron generation as well as a movable paddle with a CCD camera view for controlling the production of such runaways.

WBS Element: 315	WBS Level: 4
WBS Title:	**Spectroscopic and Visible Diagnostics**
Description:	This WBS element consists of those spectroscopic and visible diagnostics that are required for initial ECH plasma operation. They include a CCD camera with an $H_{\square}$ filter for viewing the plasma shape from a tangential port, three Filter scopes for measuring selected impurity lines, and a visible spectrometer for more detailed analysis.

QPS WBS Dictionary
Diagnostics (WBS 3)

WBS Element: 316	**WBS Level: 4**
WBS Title:	**Magnetic Field Mapping**
Description:	This WBS element consists of the equipment need for characterizing the magnetic field quality. It includes a moveable electron beam and a fluorescent screen. An image-intensified CCD camera will be used to view the beam impact on the screen.

WBS Element: 32	**WBS Level: 3**
WBS Title:	**Phase 2 Diagnostics, Upgrades**
Description:	These diagnostics have been identified during the QPS conceptual design process as being needed to carry out the compete mission. *These diagnostics are not included as part of the QPS MIE project.*

WBS Element: 33	**WBS Level: 3**
WBS Title:	**Phase 3 Diagnostics, Collaborators/Optional**
Description:	These diagnostics are at present anticipated to be too costly (and not essential) for the QPS experimental program or are not presently sufficiently well developed to include in the reference QPS experimental program. *These diagnostics are not included as part of the QPS MIE project.*