# QPS Fabrication Project
# Work Breakdown Structure (WBS) Dictionary
# Power Systems (WBS 4)

## -DRAFT-

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# QPS WBS Dictionary
# Power Systems (WBS 4)

| WBS Element: 4 | WBS Level: 2 |
|---|---|
| **WBS Title:** | **Power Systems** |
| **Description:** | The QPS Fabrication Project includes all Electrical Power System capabilities required for the QPS coil sets during anticipated phases of operation.<br><br>All equipment in the Construction Project will be installed prior to first plasma .<br><br>Included in the Construction Project are only the new systems that did not exist for the ATF project, such as coil fault protection and interfaces with the new I&C systems. The power supplies will be moved from their current site and made operational as part of a different project.<br><br>This summary-level WBS element consists of the electrical power systems needed by the NCSX device and facility. Electrical Power Systems (WBS 4) includes the following elements:<br>• Site Power Supply Systems (WBS 41);<br>• Magnet Power System (WBS 42);<br>• Control and Protection Systems (WBS 43);<br><br>Electrical Power Systems (WBS 4) includes bus up to the interface with the subsystems, typically at the stellarator core inside the pit boundary. Power supplies for plasma heating systems are not included in Electrical Power Systems (WBS 4), but rather in Auxiliary Systems (WBS 2). Only a single 28-GHz ECH system is required for first plasma. The power supply will be provided as part of the facility move and is not included in the project cost. |

| WBS Element: 41 | WBS Level: 3 |
|---|---|
| **WBS Title:** | **Site Power** |
| **Description:** | This WBS element consists of the following subsystems:<br>• Substation and Utility Interface (WBS 411); and<br>• AC Power Distribution System (WBS 412). |
| **WBS Element: 411** | **WBS Level: 4** |
| **WBS Title:** | **Substation and Utility Interface** |
| **Description:** | This WBS element consists of the effort to design and reconfigure substation connections to the power supplies. This work is covered under the facility move and is not part of the QPS Project. |
| **WBS Element: 412** | **WBS Level: 4** |
| **WBS Title:** | **AC Power Distribution System** |
| **Description:** | This WBS element consists of the effort to design and install AC power in the test cell pit. |

# QPS WBS Dictionary
# Power Systems (WBS 4)

| WBS Element: 42 | | WBS Level: 3 |
|---|---|---|
| **WBS Title:** | **Magnet Power System** | |
| **Description:** | This WBS element consists of the following subsystems:<br>• Refurbishment of power supplies (WBS 431);<br>• Buswork extensions (WBS 432); and<br>• Move power supplies (WBS 433). | |
| **WBS Element: 421** | | **WBS Level: 4** |
| **WBS Title:** | **Refurbishment of Power Supplies** | |
| **Description:** | This WBS element consists of the effort needed to refurbish the existing power supplies after they are moved from the Y12 to the X10 site. This effort is assumed to be costed as part of the move (WBS 423). However, if additional work is needed, it will be performed under this WBS element as part of the project. | |
| **WBS Element: 422** | | **WBS Level: 4** |
| **WBS Title:** | **Buswork extensions** | |
| **Description:** | This WBS element consists of the effort to design, fabricate, and install buswork from the new power supply building to the test cell pit. This effort is part of the move and is not part of the QPS project. | |
| **WBS Element: 423** | | **WBS Level: 4** |
| **WBS Title:** | **Move Power Supplies** | |
| **Description:** | This WBS element consists of the effort to relocate the magnet power supplies from the Y12 site to the X10 site, and includes dismantling, moving, re-installing, and testing each power supply into a dummy load. This effort is part of the move and is not part of the QPS project. | |

| WBS Element: 43 | | WBS Level: 3 |
|---|---|---|
| **WBS Title:** | **Control and Protection Systems** | |
| **Description:** | This WBS element consists of the following subsystems:<br>• Electrical Interlocks (WBS 431);<br>• Kirk Key Interlocks (WBS 432);<br>• Real Time Control Systems (WBS 433);<br>• Instrumentation Systems (WBS 434);<br>• Coil Protection Systems (WBS 435); and<br>• Ground Fault Monitoring System (WBS 436). | |
| **WBS Element: 431** | | **WBS Level: 4** |
| **WBS Title:** | **Electrical Interlocks** | |
| **Description:** | This WBS element consists of the effort to design, fabricate, and install an electrical interlock system for QPS power supplies. This system will be installed as part of the move and is not included in the QPS project. | |
| **WBS Element: 432** | | **WBS Level: 4** |
| **WBS Title:** | **Kirk Key Interlocks** | |
| **Description:** | This WBS element consists of the effort to design, procure, fabricate, and install Kirk Key interlocks for the QPS power supplies. The effort to design and install this system is part of the move, and is not included in the QPS project. | |
| **WBS Element: 433** | | **WBS Level: 4** |
| **WBS Title:** | **Real Time Control** | |
| **Description:** | This WBS element consists of the effort to develop the specification of the hardware requirements and software algorithms to be provided by WBS 5 (Central I&C) for the real time digital feedback control of the power supply system, including the high-speed digital input and output links. | |
| **WBS Element: 434** | | **WBS Level: 4** |
| **WBS Title:** | **Instrumentation** | |
| **Description:** | This WBS element consists of the effort to design, specify, procure, install, and implement current and voltage measurements for the Modular, PF, and TF coils. This instrumentation exists on the power supplies and will be retained as part of the move. It is not part of the QPS project. | |
| **WBS Element: 435** | | **WBS Level: 4** |
| **WBS Title:** | **Coil Protection** | |
| **Description:** | This WBS element consists of the effort to design, specify, procure, program, and implement hardware and software as required to provide 1) digital coil protection system and 2) ground fault detection system for the Modular, PF, and TF coil systems. The digital coil protection system uses the coil current measurements as input and declares a fault if electrical, thermal, or mechanical limits are exceeded. The ground fault detection system declares a fault if excessive ground current flow is detected. | |
| **WBS Element: 436** | | **WBS Level: 4** |
| **WBS Title:** | **Ground Fault Monitor** | |
| **Description:** | This WBS element consists of the effort to design, specify, procure, implement a ground fault monitoring system that serves to detect the integrity of machine grounds and generate alarms in case of spurious grounds. | |