QPS MODULAR COIL WINDING & ASSEMBLY*

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The Quasi-Poloidal Stellarator (QPS), currently in the advanced conceptual design phase, is a low-aspect-ratio ($R/a \geq 2.3$), concept exploration experiment with a non-axisymmetric, near-poloidally-symmetric magnetic field. The stellarator core consists of the modular coil set that provides the primary magnetic field configuration. The modular coils represent the most difficult part of the core design and fabrication. One of the most critical issues is the cooling of the winding pack conductor. It also is one of the hardest to solve due to space constraints, variable conductor behavior, coolant effectiveness, complex electrical circuits, high stresses, impregnation issues, vacuum can integrity, welding/brazing damage, and the extremely complex conductor leads interface and connection. Two possible conductor cooling concepts being evaluated are: (1) an internally cooled conductor having a copper tube filled with a solder-like material imbedded in the conductor cable, and (2) An externally cooled winding pack using copper cladding inboard and copper chill plates outboard of the pack. The internally cooled conductor concept appears very attractive due to a much more effective active cooling of the conductor than the copper cladding/chill plates. However, the conductor itself will be very difficult to "hand" wind on the coil forms due to it's increased stiffness from the tube and internal solder material that prevents the inner tubing from crimping and crushing during fabrication and winding. Another concern is the assurance that the solder material can be completely evacuated from the tubing (~120 ft/turn x 14 turns) to prevent any outright blockages or restrictions of the coolant flow. Once the conductor tubing is cleared, the next big issue focuses on separating the cooling tube from the conductor at the electrical connection interface. The QPS device will be located at the Oak Ridge National Laboratory. R&D work pertaining to the fabrication and winding of the modular coils will be done at the Magnet Development Laboratory (MDL). The facility layout, power requirements, tools, and equipment have been designed and specified. The modular coil castings will be shipped from the foundry to MDL mounted on carts". The castings will remain mounted to the carts during transport and the carts will provide a work platform for prepping, winding, welding, and potting of the coils. The carts will have an electric motor drive to rotate the coils which have shafts attached to each end of the castings. This will enable optimum positioning of the coils during winding and fabrication. An overhead system has been designed for supporting the spools of conductor and for feeding the conductor in the correct orientation, groupings, and tensioning.

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