Modifications made between the E866 and E906 Target Systems

Components in the E906 target system not found in the E866 target system	**Safety Implications**
New cryocoolers with independent compressors and flex lines.	The new cryocoolers, unlike those used for the E866 target, will not require a large helium source for their operation. This will eliminate all ODH issues that may arise from an uncontrolled release of such a helium source into the hall.
New target condenser assemblies.	The new condenser assemblies will be pressure tested prior to installation.
New target table motor, controller, and encoder. The target table will also have a larger dynamic range (36.5" for E906, compared to 32" for E866).	The new target table motor is a higher torque version of the same brushless motor (Anaheim Automation) used for E866. All controllers will be installed outside of the target enclosure, and will not be a source of ignition. The increased dynamic range of the target table will require extra slack in the cryocooler flex hoses, vacuum hoses, and instrumentation cables.
New target venting system. The primary relief valves will be connected to PVC pipes via metal flex lines in order to vent the gas to the outside of the building. The E906 target enclosure will consist of concrete walls on five sides, and vertical transparent fire-resistant vinyl strips on the upstream plane.	Venting the gas outside will ensure safety during power outages and target shutdown. The enclosure itself will be a backup in case of a catastrophic failure.
The fan for the target enclosure will run continuously instead of activating on alarm.	Since the fan for the E866 target was only activated when the flammable gas detector was triggered, a continuous running of the fan will result in safer operation.

New manual valves will be added to both the hydrogen (MV-14-H) and deuterium (MV-114-D) supply lines.	There are flex lines upstream of both of these valves. If there is a line failure upstream of these valves, the valves can be closed in order to isolate the target flask from the failed system. There are no safety hazards associated with the installation and operation of these valves.
New manual valves will be added to the hydrogen (MV-08-N) and deuterium (MV-108-N) pneumatic lines controlling the gas vent valves PV-H2VV and PV-D2VV.	In the E866 target system, both pneumatic lines were controlled by a single manual valve. The addition of independent valves allows for diagnosis of one system without affecting the operation of the other system.
The E906 target system will use a different control system than that used for E866.	The programmable logic controller (PLC) used for E906 are used widely at Fermilab, and will not present any safety hazards. The PLC will be located outside of the experimental hall to avoid radiation damage to the memory and CPU.
New instrumentation for temperature sensors. The E906 target system will use calibrated resistive sensors for the target flask and condenser (CERNOX) instead of the 100Ω resistors used for E866. The internal vapor pressure of the flask and condenser will also be measured to give an accurate measure of the temperature.	Interlocks related to liquid inside of the flasks and condensers are connected to the vapor pressure readout. There are no interlocks connected to the temperature sensors. Therefore, a failure or an erroneous reading of the sensors will not present a safety hazard.
New relays will be installed to control the valves on the pumpcarts. While the pump carts used for E906 will be those from E866, the relays controlling the valves on these carts will be newly acquired. The relays will be controlled remotely by the PLC.	The relays will be installed outside of the target enclosure, and therefore will not be a source of ignition. Failure of these relays will result in the pumpcart valves to return to their normal state, which will not present a safety hazard.