INITIAL COOLING CHANNEL ENGINEERING DESIGN AND COSTING STUDY

Engineering Design Requirements:

The basis for the design represented on fig. Super FOFO LATTICE 1 and Super FOFO LATTICE 2 are the data on the "INITIAL PARAMETERS FOR STUDY 2 – DESIGN A - - DRAFT 4 ", Section 2.11 Cooling LATTICE and section 2.12 Cooling RF and absorbers.
The data was plotted as a geometric boundary parameter outlining a vertical cross section of the channel components.

Design Development:

Ones the lattice channel components boundary parameters were established, this being location and since of super conducting solenoid magnets, Rf cavity and liquid hydrogen absorber, the supporting elements consisting on outer pressure vessel (vacuum chamber) with supporting structure, cryostat enclosures for the super conducting solenoids and the liquid hydrogen absorber vessel were laid out taking in account the space requirements for: a) assembly and disassembly feasibility, b) structural support strength capability, c) accessibility for connections of electric power, instrumentation, cryogenic ducting and insulation.

Design criteria:

The logical approach to the design is of this hardware is by it's functionality that suggest a modular construction. Each physical lattice is compose of 2 modules to facilitate assembly and strengthening the mechanical stability of the lattice components particularly the super conducting solenoids that generate large Peak Field Stresses.

The **main module** consisting of the RF cavity surrounded by the coupling field magnet located on the lattice longitudinal geometric center, this is the larger of the 2 modules consequently the vacuum chamber is built with the support structure for the entire assembled lattice, also it is split to assemble the coupling field magnet, this magnet will be pre assembled with its own cryostat and vacuum chamber as a package.

The **second module**, contain the liquid hydrogen absorber and the 2 short solenoid focusing magnets. The 2 solenoids are also packaged as a unit, enclosed inside of a common cylindrical cryostat containing shielding and thermal dividers. This tubular cryostat is constructed with a transverse lined clearance hole that allows duct connections to the liquid hydrogen absorber. The absorber is installed through the bore of the magnets cryostat and positioned on the cryostat geometric center with its connecting ports lined up with the transversal access holes of the cryostat.

From all of the components considerable effort has being expended on the design of the **liquid hydrogen absorbers** with emphasis on safety. The absorber window thickness requirement imposes careful consideration on all the design aspects of which: factors of size, operating pressure and material of construction are still under study. Preliminary ANSYS analysis using the material properties corresponding to aluminum 6061-T6 indicate that windows shaped with tapered wall thickness will allow the minimum thickness, specified in the study 2 report, at operating pressures between 1 to 2 atmospheres. Farther analysis promises strength optimization capabilities by combining configuration with material properties beyond the customary design standards.

A short survey of vendors for the fabrication of this windows show that regardless of the method of construction, fabricators hesitate to commit assurance in the quality and accuracy of thickness under 0.015" (381m) dimension, one of their main concerns is the possibility of finding voids or bubble inclusions in the material and this apply to all the candidate materials.

Currently the effort at the Mississippi University, intents to investigate simpler methods of fabrication that include chemically thinning the material, this will avoid the stress residues on the finish product at the finishing stages typical of machining or forming by all the currently known methods.

AlBeMet162 material appear a desirable choice for the construction of the absorber windows because of its composition (65 % beryllium 35 % aluminum) may allow us to construct thicker window walls, which will take care of the potential void inclusions, and because of its higher tensile strength that will allow flatter configuration favorable for the beam and hydrogen dynamics.

We shall take in account the fact that AlBeMet162 does not follow the processing procedures of Aluminum just because it has the Aluminum chemical component in its composition. This is a two-phase material of (Be) and (Al). for which the prototype manufacturing investigation with the aluminum along may not directly apply to AlBeMet162; there fore, a parallel effort on the window design with this material shall be programmed

Cost:

An intent was made to include all the foreseeable elements in the SuperFOFO cooling channels design for the estimate of costs based on the current requirements specified on the study 2 report, as represented on the layouts attached; however, the layouts as well as the cost estimates shall be considered as preliminary, in consideration to the multitude of engineering detail not represented yet requiring farther clarifications of physics requirements as well as engineering effort.