Fermilab

Particle Physics Division
Mechanical Department Engineering Note

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Project: COUPP

Title: 30 liter Bubble Chamber Scintillator Veto Vessel

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Reviewer(s):

Key Words: Scintillator, Veto

Applicable Codes: n/a

Abstract Summary:

Mike Crisler, Erik Ramberg, Andrew Sonnenschein, Steve Brice and Russ Rucinski have discussed use of a liquid veto to surround the 30 liter bubble chamber for Coupp. The design described here uses commercially available, one piece plastic (high density polyethylene, HDPE) water tanks to provide primary and secondary containment for the liquid veto. If water is the veto medium, secondary containment is not needed. But if mineral oil or liquid scintillator (mineral oil with 5 to 10 percent pseudocumene) is the liquid veto, then incorporating a secondary containment is necessary.

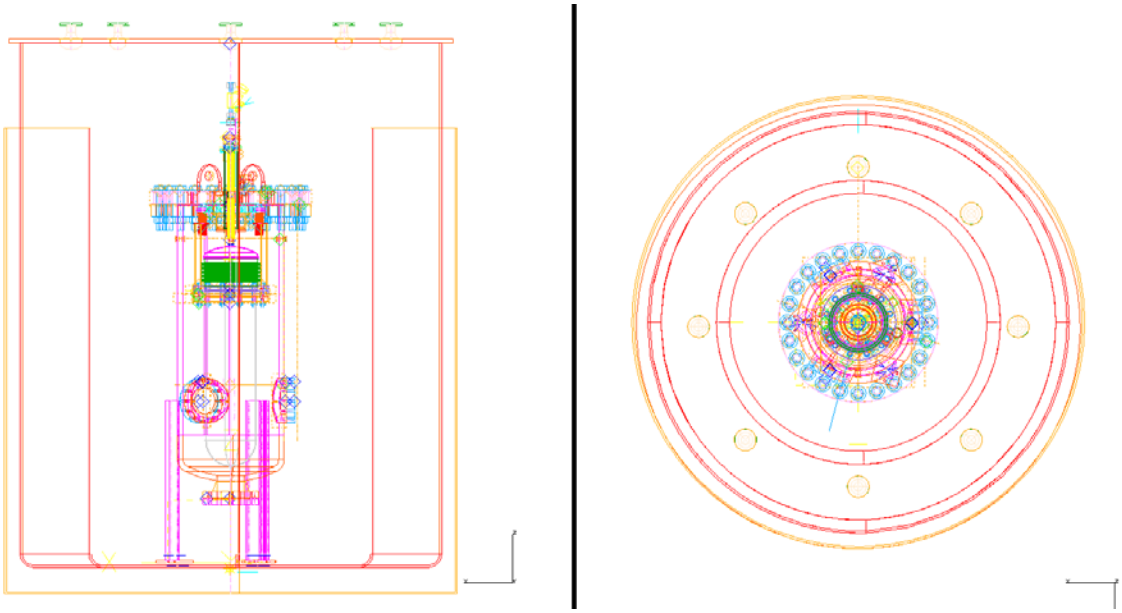

Image 1, Side and Top view of the 30 liter chamber in a liquid container.

The solid model of the 30 liter chamber prepared by Rick Reinert has been used in this assembly.

Inner vessel is a made from a 4000 gallon capacity, 95 inch diameter by 140 inch tall commercially made HDPE potable water tank. The potable water tanks are made with black HDPE to reduce bacteria growth by blocking sunlight. An opaque vessel is desirable since that reduces the effort needed to light tight it.

The outer vessel is made from a 4000 gallon capacity, 102 inch diameter, 125 inch tall commercial potable water tank, also with black HDPE.

Both tanks are manufactured with dome shaped roofs and entry man-way ports in the top. Height dimensions listed above are to the top of the man-way ports. These dome shaped roofs will need to be removed to use the tanks in this application. After cutting, the height of the inner and outer tanks will be 118 and 105 inches respectively.

See http://www.plastic-mart.com/class.php?cat=9 for a list of available HDPE potable water tanks and price information. Each tank used in this design has a catalog price of $1700.

Image 1 also shows a 64 inch diameter by 121 inch tall, 1500 gallon capacity inner tank. This diameter is likely too small to allow adequate access to the vessel and vessel cameras. It is also likely too short (at 105 inches tall, after having the roof removed) to provide sufficient liquid above the vessel. The primary advantage of this vessel is that it reduces the liquid veto volume.

Assuming the inner and outer tanks are co-axial, the resulting 3.5 inch annular space can be insulated with expanded perlite insulation giving about 9 cm of insulation.

Because the bottom has to support the weight of the bubble chamber and the liquid, consider using perlite concrete (1 part Portland cement and 8 parts perlite) as the insulation material. Once cured, the perlite concrete has a compressive strength of 80 psi and a thermal conductivity value of 0.5 BTU/h-ft-F.

Heat loads assuming the veto liquid is kept at 40 C (104 F) and the building is at 20 C (68 F), will be in the 500 Watt range.

Included in Image 1 is the first pass attempt of adding photomultiplier tubes to the top of the vessel. Six tubes, each nominally five inches in diameter, have been shown located on a 72 inch diameter circle.

Russ Rucinski has produced a list of the pipes, tubes, and cables needed to pass from the vessel, through the veto region and to points external to the outer tank. First pass routing of these utilities will be thru the upper PMT support plate.

Preliminary Order of Magnitude Material and Services Cost Estimate:

Inner vessel	$1700
Outer vessel	$1700
Liquid Secondary Storage vessel	$1700
Secondary Storage secondary containment	$1700
Delivery charges for the above vessels	$1500
Bottom perlite concrete	$1000
Side Wall perlite concrete or blown in insulation	$500
Upper PMT Support Plate	$500
Reflective Liner Material	$300
Liquid Circulation, Filtering, and heating system	$2000
Sub total	$12,600