GERDA – NIER Risc Analysis

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GERDA Collaboration Meeting at Ringberg
12 – 14 February 2007

New Safety Review (2006)

- May 29: A. Scaramelli outlines need for new safety review, new system!
  Proposes NIER Engineering, Bologna, which did review for many other LNGS experiments.
- Work on Version 0.2 of Technical Proposal for Safety Review in progress ► www.mpi-hd.mpg/GERDA/TPRO.html
- Jun 15: Safety meeting at LNGS, with LNGS safety experts, NIER representatives & GERDA representatives ► focus on study of top events.
- Jul 20 : Meeting with NIER at Bologna; preliminary report:
  ► 3rd wall helpful but not indispensable!
- Sep 19: Meeting at CERN, announced as final – but new information
  ► evaporation rate must be less than 10000 m³/h (by factor 3 reduced)
  ► request to provide more information on time dependence of rate
- Oct 05: Report on evaporation rate and its reduction to 10000 m³/h delivered
  ►heat transfer for LAr deduced from experiments done at MPI HD

- Nov 16: Meeting at Bologna of Carla and KTK with NIER A; final clarifications
- Dec 06: Draft of final NIER risc analysis delivered : 3 parts,
  see new GERDA safety document page
  ► www.mpi-hd.mpg/GERDA/internal/index.html -> Safety Documentation

GERDA Safety Documentation Webpage

Safety Documentation

Implemented by recommendation of GERDA Board.

General

Technical Proposal, Version 0.2, Draft of 23 June 2006 pdf

Please provide your safety relevant documents to our GLIMOS, Marco Balata, or to the Technical Coordinator!

Risc Analyses

NIER Preliminary Risc Analysis, Final Versions, December 2006
NIER: Cryogenic and Water Tank System, Risc Analysis, Technical Analysis - Phase 2, 13 Sep 06, Rev. 1 pdf
NIER: Cryogenic and Water Tank System, Risc Analysis, Technical Analysis - Phase 2, 08 Sep 06, Rev. 0 (italian) pdf
NIER: Cryogenic and Water Tank System, Preliminary Risc Analysis, Technical Analysis - Phase 1, 08 Sep 06, Rev. 3 pdf
NIER: Cryogenic and Water Tank System, Preliminary Risc Analysis, Technical Analysis - Phase 1, 07 Sep 06, Rev. 2 pdf
NIER: Annex_1, References for failure rate data pdf

TÜV Nord: GERDA cryostat & Basissicherheit, 07 Jul 2005 pdf
Air Liquide: Safety Relief Devices, Calculation Note pdf
Air Liquide: FMECA report for Cu cryostat, 01 Jul 2005 pdf
Air Liquide: HAZOP report for Cu cryostat, 01 Jul 2005 pdf
Piping and Instrumentation Diagram, 24 Jun 2005 tif

Water Tank and Auxiliary Plants

Cryostat

Details of GERDA cryogenic vessel insulations, Draft of 22 Jan 2007 pdf
Model Studies of the Gas Exhaust Rate for a Failure Scenario of the GERDA Cryostat, Draft of 05 Oc
Technical Specification - Cryogenic Liquid Nitrogen/Argon Vessel, 8 Aug 2006 pdf
Stainless Steel Cryostat Drawing GC-1001-2006-05 pdf or dwg
1.4571 data sheet pdf
welding test Antonius Vesselheads
Stainless Steel certificates pdf
Calculations for cryostat pdf

Superstructure

Safety Documents and Information from LNGS

Prevention & Protection Service includes Admittance Rules, Safety Guide, LNGS Emergency Plan,

Operational Procedures Documents

Operational Procedure OPER-GE-001 R.3 pdf

Misc

Stainless Steel Data Sheets, Deutsche Edelstahlwerke
"Applying 'Basissicherheit' to the GERDA cryostat", GERDA safety meeting at LNGS, 5 Jul 2005
RSK-Leitlininien DWR - Rahmenspezifikation Basissicherheit von ... pdf

Effect of Volumetric Ratio and Injection Pressure on Water-Liquid Nitrogen Interaction pdf

New Safety Review (2007)

- Jan 15: Safety meeting at CERN, with LNGS safety experts, NIER representatives & GERDA representatives
  - ► final meeting on NIER risc analysis, all participants satisfied
    (summary docu: Details of GERDA cryogenic vessel insulations by KTK)
  - ► new 2nd opinion and LNGS concluding document to follow

NIER Phase 3: Additional Assessment

Indice

► next page

CONSEQUENCE → FREQUENCY ↓ a) occ/year b) Ev/h	MORTAL OR IRREVERSIBLE	MAJOR	SERIOUS	MINOR	NO RELEVANT EFFECT
Frequent a) > 1 ev/anno b) $<1.1*10^{-4}$/h					
Probable a) 10^{-1} /anno - 1/anno b) $5.7*10^{-6}$ /h – $1.1*10^{-4}$/h					
Occasional a) $3*10^{-2}$ /anno - 10^{-1}/anno b) $2.8*10^{-6}$/h - $5.7*10^{-6}$ /h					
Remote a) $3*10^{-2}$ /anno - $3*10^{-3}$/anno b) $2.8*10^{-7}$/h - $2.8*10^{-6}$/h				Evento N° 1	Evento N° 2
Improbable a) $3*10^{-4}$ /anno - $3*10^{-3}$/anno b) $5.7*10^{-8}$/h - $2.8*10^{-7}$/h					Evento N° 5 Evento N°8
Not Credible a) < $3*10^{-4}$/anno b) < $5.7*10^{-8}$/h		Evento N° 6 Evento N° 3	Evento N° 10		Evento N°9

N.B. = Top 1, Events 7 and 11 are not considered in the table because of their occurrence frequencies that are lower than the category "extremely unlikely"

New Safety Review (2007)

NIER Phase 3: Additional Assessment

Indice

F Conclusions and suggestions

All the accidental conditions analysed and evaluated within a probability range of occurrence with a $10^{-4} \div 10^{-5}$ ev/year limit, appear to be suitably protected and to have acceptable consequences.

1

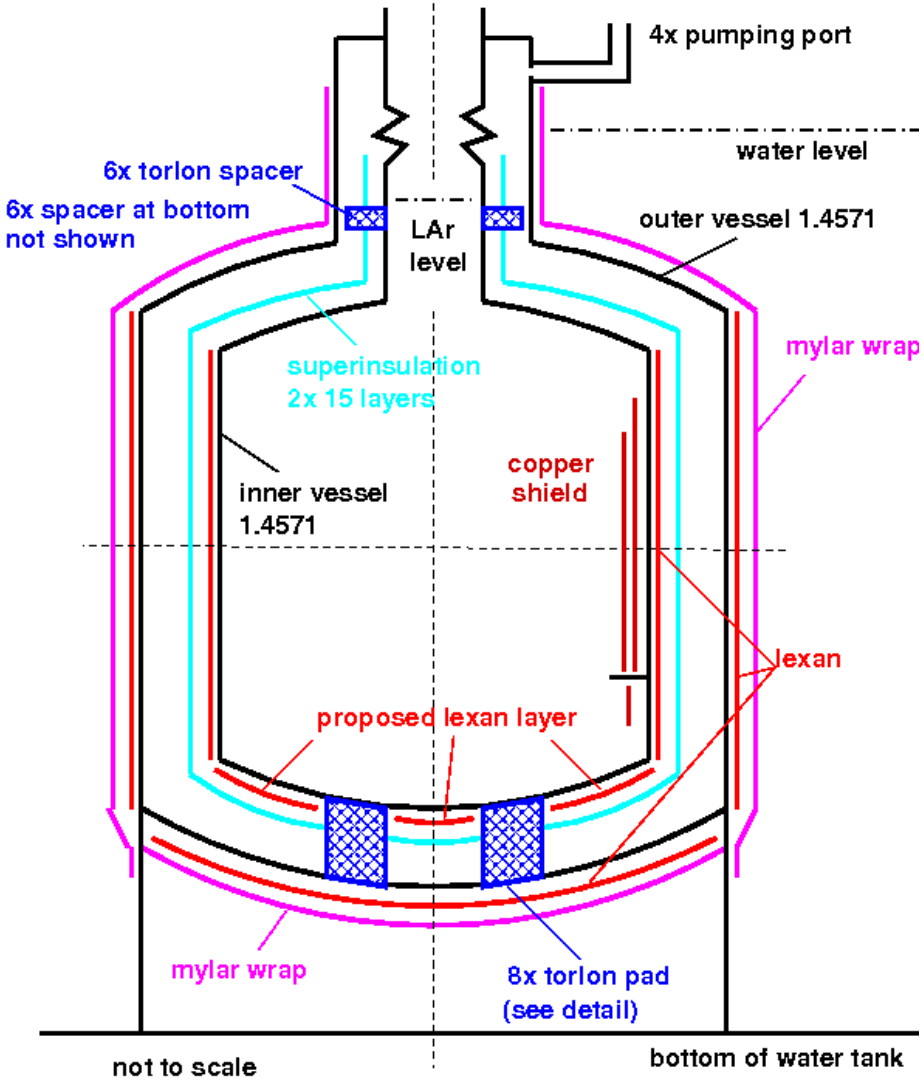
Some aspects of the Water Tank – Cryostat system require a final clarification in the right context. This means that it is necessary to specify the final characteristics, the placing and the fixing of the two layers as foreseen. To this purpose we suggest placing the two layers also in the bottom area if possible, as they appear to be useful.

2

3 Lastly, we suggest once more the differentiation of the staffs in charge of the tests and of the inspections.

Cryogenic Vessel Insulations

figure shown / discussed at CERN meeting:

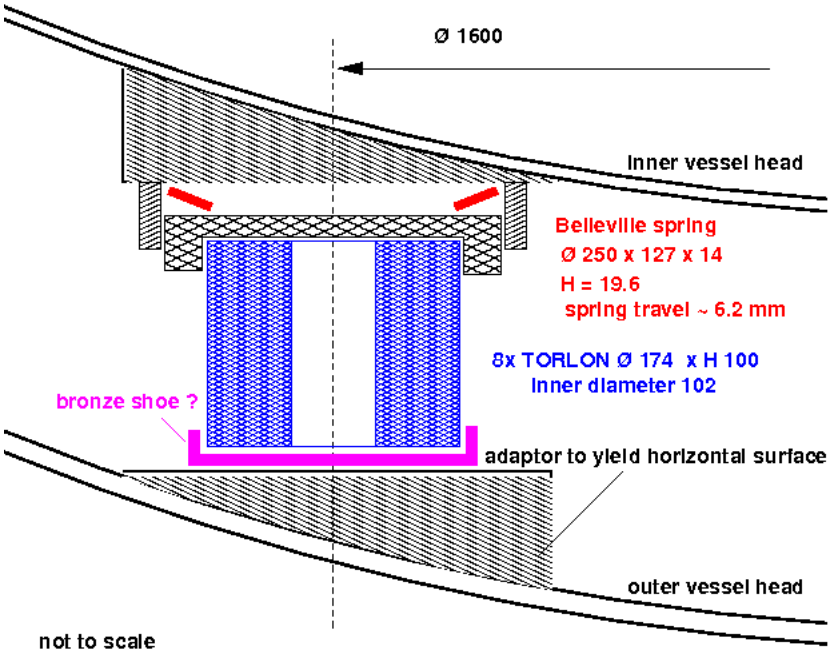


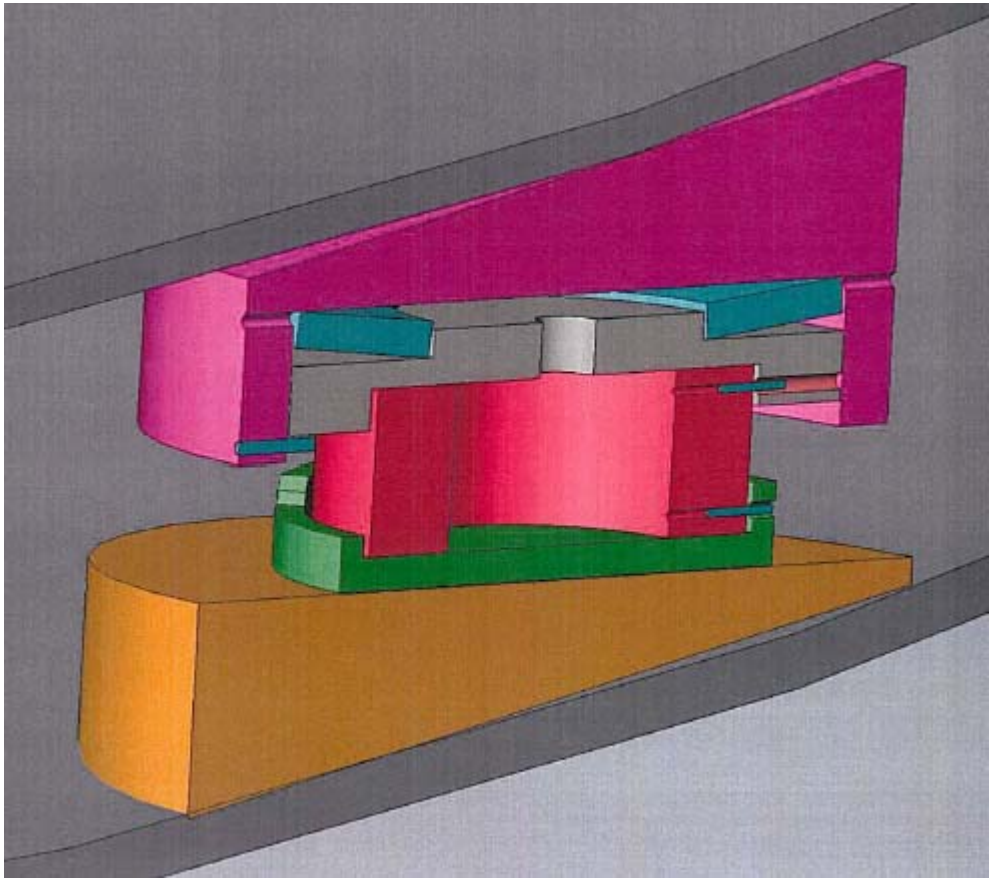
Agreement about implementation of various shields resp. barriers :

- inner vessel - horizontal shell: Makrolon thermal shield, 6mm
- outer vessel - all in contact with water : styrofoam, Makrolon 2x 3mm, mylar wrap (not finally fixed)

Layout of the 8 Torlon Support Pads

figure shown / discussed at CERN meeting:





Conclusions►

- New risk analysis by NIER completed.
  GERDA safety concept accepted by LNGS.
  ► cryostat will have internal and external thermal barriers;
  ► waiting for new 2nd opinion and LNGS final safety review document.

- Webpage for compilation of safety relevant documents initiated.
  ► Please have a look to be fully informed !
  ► Please submit your relevant documents !