CURRENT STATUS OF MELCOR 2.2 FOR FUSION SAFETY ANALYSES

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INTRODUCTION

- ***MELCOR is a fully integrated code***, developed at Sandia National Laboratories (SNL) for the US Nuclear Regulatory Commission (USNRC), ***able to simulate*** the ***thermal-hydraulic phenomena*** in steady-state and transient condition ***and the main phenomena occurring in fission plant during a severe accident.***
- ***The Idaho National Laboratories (INL) made fusion reactor specific modifications*** to MELCOR 1.8.2 and then **introduced** these modifications into **MELCOR 1.8.6**.
- **MELCOR fusion** is currently adopted as one the ***reference code for the safety analyses of fusion reactors***.
- During the last two decades, ***MELCOR capabilities*** are being ***extended by SNL to analyze*** non-LWR fission technologies and also ***fusion related facilities*** (ITER, DEMO, IFMIF-DONES, etc.). The current version is the MELCOR 2.2.

GOAL OF THE WORK

- Currently, MELCOR 2.2 still ***does not have implemented some*** **models** needed ***to carry out analyses*** of some **specific phenomena** occurring ***in fusion facilities***.
- An activity coordinated by ENEA has been launched in order to identify the necessary ***models needed for fusion safety analysis*** to be implemented in MELCOR 2.2.
- This work ***describes the code modelling needs*** to address fusion safety analyses, ***ranking their priority*** for implementation according to the user expeience.
- It is described **if the models have been already implemented in *MELCOR fusion*** or if the **phenomena of interest can be simulated through specific methodologies**.

1°	2°	3°
IDENTIFICATION *of code modelling needs for fusion safety analysis*	***DESCRIPTION of code modelling needs for fusion safety analyses***.	***RANKING*** *of code modelling needs for fusion safety analyes*

MODELS NEEDED TO ADDRESS FUSION PLANT SAFETY ISSUES

The priority for model implementation from 1 (low) to 3 (high) has been assigned by the authors.

Low priority **Mid priority** **High priority**

Code modeling needs	Priority
Inclusion of additional working fluids with multiphase capabilities	3
Implementation of the possibility to use different fluids simultaneously in the same code input	3
Models for chemical reactions for selected working fluids	2
Model for steam oxidation of Plasma-Facing-Component (PFC)	2
Model for air oxidation of the Plasma-Facing-Component (PFC)	2
Models for turbulent and inertial aerosols deposition	2
Models for aerosols deposition with different carrying gas and mixtures	2
Model for aerosols resuspension	2
Extension of the aerosols deposition and resuspension modelling to consider the remnant magnetization effects	1
Models for aerosols transport in multifluid (multi-working fluid) simulation.	2
Implementation of specific heat transfer correlations for simulating Helium and other working fluids in the geometry of interest.	2
Standard Scrubber model in FL Package for Helium.	1
Inclusion of dissolved NCG species within working fluids	2
Implemention of magnetic pump modelling (for design) and features (e.g. coast-down, etc.)	1
Inclusion of MHD effects on heat transfer correlations and pressure drop evaluation (for design)	1
Extension of the water properties below the triple point	2
Model for air condensation onto cryogenic structures	2
Model for Helium condensation onto cryogenic structures	2
Inclusion of the possibility to work with low temperature operations (>3K) and cryogen working fluids	2
Extension of material physical properties to cryogenic range	3
Implementation of enclosure radiant heat transfer	2

CONCLUSIONS

The development of a common MELCOR 2.2 version release, that ***includes also models for fusion safety analyses, allows*** to ***use all the state-of-art features implemented in the code*** and to use of capability of ***SNAP*** for the development of input-decks, post processing of the data, and uncertainty analsyes.

This activity, based on the feedback of several MELCOR code users, presents a ***first contribution*** **to identify the code modelling needs** necessary ***to be implemented***, in safety analyses code (e.g thermal-hydraulic system codes, severe accident code, etc) to be used for **fusion facilities safety analsyes**.