Italian National Agency for New Technologies, Energy and Sustainable Economic Development

PHYSICAL MODELS NECESSARY TO BE IMPLEMENTED IN MELCOR_2.2 FOR FUSION REACTOR SAFETY ANALYSES AND THE CURRENT MODEL ALREADY IMPLEMENTED IN MELCOR FUSION

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ENEA ACTIVITIES IN THE FIELD OF SEVERE ACCIDENTS (FUSION REACTOR)

- During the last EMUG meeting in Zagreb (25-27 April 2018), there was a very interesting discussion about the physical models necessary to be implemented in MELCOR_2.2 for fusion reactor safety analyses and the current model already implemented in MELCOR fusion code.
- Since the session4 ("GEN IV and Fusion Applications") was chaired by ENEA, ENEA proposed an action that was agreed by all the Colleagues attending the meeting: ENEA will contact all the EMUG Partners, involved in Fusion related activity, to collect the information about physical models necessary to be implemented in MELCOR_2.2 for fusion reactor safety analyses and the current model already implemented in MELCOR fusion.
- ENEA has already contacted all the EMUG Partners to collect the information about physical models necessary to be implemented in MELCOR_2.2 for fusion reactor safety analyses and the current models already implemented in MELCOR fusion.
- These are the information requested:
    - description of phenomenon of interest;
    - safety relevance of the phenomenon for fusion reactor;
    - rank of importance (1: low; 2: medium; 3: High) ==> priority for code development;
    - if models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version.
- The Partner sent the informations that has been collected by ENEA and here summarized.

SUMMARY OF THE PHYSICAL MODELS NECESSARY TO BE IMPLEMENTED IN MELCOR_2.2 FOR FUSION REACTOR SAFETY ANALYSES

ISSUE N	ISSUE DESCRIPTION	Priority	Complexity of implementation	MELCOR_FUSION REFERENCES
1	Introduce additional working fluids with multiphase capabilities	3		[2][3]
2	Implementation of the possibility to use different fluids in different circuits at the same time during the calculation	3		-
3	Introduce models for chemical reactions in the case of different working fluids	2		[6][7][13]
4	Model steam oxidation of the Plasma-Facing-Component (PFC)	2		[2][4]
5	Model air oxidation of the Plasma-Facing-Component (PFC)	2		[4]
6	Introduce models for aerosols turbolent and inertial deposition	2		[2]
7	Introduce models for aerosols deposition with different carrying gas and mixtures	2		[2]
8	Introduce aerosol resuspension model	2		[9]
9	Extend the deposition and resuspension modelling to take into account remnant magnetization effects	1		
10	Introduce models for aerosols transport in multifluid (multi-working fluid) simulation.	2		-
11	Implementation of specific heat transfer correlations for simulating He as working fluid in the geometry of interest.	2		-
12	Standard Scrubber model in FL Package for Helium.	1		-
13	Introduce dissolved NCG species within working fluids	2		-
14	Implement magnetic pump modelling (for design) and features (e.g. coast-down, etc)	1		-
15	Include MHD effects on heat transfer correlation and pressure drop evaluation (for design)	1		-
16	Extend the water properties below triple point temperature	2		[2]
17	Air condensation onto cryogenic structures	2		[4][14]
18	Helium condensation onto cryogenic structures	2		[2]
19	Allow low temperature operations (>3K) and cryogen working fluids	2		
20	Extend material physical properties to cryogenic range	3		
21	Enclosure radiant heat transfer	2		[2]

SUMMARY OF THE PHYSICAL MODELS NECESSARY TO BE IMPLEMENTED IN MELCOR_2.2 FOR FUSION REACTOR SAFETY ANALYSES

- WORKING FLUID:
  - 1: ADDITIONAL WORKING FLUIDS WITH MULTIPHASE CAPABILITIES
  - 2: USE OF DIFFERENT FLUIDS IN DIFFERENT CIRCUITS
  - 16: EXTEND THE WATER PROPERTIES
  - 19: LOW TEMPERATURE OPERATIONS (>3K) AND CRYOGEN WORKING FLUIDS

- MATERIAL
  - 20: EXTEND MATERIAL PHYSICAL PROPERTIES TO CRYOGENIC RANGE

- CHEMICAL REACTIONS:
  - 3: CHEMICAL REACTIONS IN THE CASE OF DIFFERENT WORKING FLUIDS
  - 4: STEAM OXIDATION OF THE PLASMA-FACING-COMPONENT (PFC)
  - 5: AIR OXIDATION OF THE PLASMA-FACING-COMPONENT

SUMMARY OF THE PHYSICAL MODELS NECESSARY TO BE IMPLEMENTED IN MELCOR_2.2 FOR FUSION REACTOR SAFETY ANALYSES

- AEROSOL
  - 6: AEROSOLS TURBOLENT AND INERTIAL DEPOSITION
  - 7: AEROSOLS DEPOSITION WITH DIFFERENT CARRYING GAS AND MIXTURES
  - 8: AEROSOL RESUSPENSION
  - 9: EXTEND THE DEPOSITION AND RESUSPENSION MODELLING TO TAKE INTO ACCOUNT REMNANT MAGNETIZATION EFFECTS
  - 10: AEROSOLS TRANSPORT IN MULTIFLUID
  - 12: SCRUBBER MODEL FOR HELIUM

- HEAT TRANSFER AND PRESSURE DROP
  - 11: HEAT TRANSFER CORRELATIONS FOR HE
  - 15: MHD EFFECTS ON HEAT TRANSFER AND PRESSURE DROP
  - 17: AIR CONDENSATION ONTO CRYOGENIC STRUCTURES
  - 18: HELIUM CONDENSATION ONTO CRYOGENIC STRUCTURES
  - 21: ENCLOSURE RADIANT HEAT TRANSFER

- SPECIFIC COMPONENT
  - 14: MAGNETIC PUMP

ISSUE N. 1: ADDITIONAL WORKING FLUIDS WITH MULTIPHASE CAPABILITIES

- Description of phenomenon of interest or issue to be addressed
  - Introduce additional working fluids with multiphase capabilities:
    - Air;
    - Lithium;
    - LiPb;
    - FLIBE (LIF+BeF2) breeder material;
    - Helium;
    - KNO_3 + $NaNO_2$ + $NaNO_3$ molten salt (HITEC) and
    - Solar salt intermediate circuit fluid, heat storage.
  - In magnetic fusion technology several breeder blanket materials can be used: the molten salt FLIBE (Li_2BeF_4), metallic lithium, LiPb, solid ceramic lithium compound, etc.
  - Different cooling fluids and breeder blanket materials are under discussion. As example, current DEMO designs involve different options for breeder blanket material and coolant (H2O/LiPb, He/LiPb, etc). Molten salt fluids with lower melting point, e.g. HITEC and Solar salt, are also used as Intermediate Heat Transport Circuit (IHTS) fluid.
  - Currently MELCOR 2.2 only uses one working fluid with multiphase capability: water. Noncondensibe gas (e.g. He) are not working fluids and are modeled in the Noncondensible Gas (NCG) Package as ideal gas.

ISSUE N. 1: ADDITIONAL WORKING FLUIDS WITH MULTIPHASE CAPABILITIES

- **Safety relevance of the phenomenon for fusion reactor:**
  - MELCOR_fusion can already use different working fluids (e.g. H2O, LiPb, He, etc.) but still only one fluid is allowed for all circuits at the same time. For example in MELCOR 1.8.5 several working fluids are allowed: FLIBE, Helium, Hydrogen, Lithium, Nitrogen, etc.
  - Different working fluids implementation is important to develop the safety analyses of fusion reactor considering its different components.
    For example cryogenic He and air as working fluid are important for safety analyses involving the cryostat.
  - Codes like TRACE and RELAP5-3D already allow the possibility of circuits with different fluids [1] during the calculation (➔ see Issue 2). These additional capabilities could be useful, for example, for Water-Cooled Lithium-Lead breeding blanket (WCLL) and Helium-cooled Lithium Lead breeding blanket (HCLL) safety analyses.
  - It is to underline:
    - Equation Of State (EOS) should be extended to low pressures (<300 Pa);
    - Possibility for the user to add libraries for other fluids;

ISSUE N. 1: ADDITIONAL WORKING FLUIDS WITH MULTIPHASE CAPABILITIES

- Rank of importance (1: low; 2: medium; 3: high) ==> priority for code development: 3
  - Air: 2
  - FLIBE 1
  - He: 3
  - HITEC: 3
  - Lithium: 2
  - LiPb: 3
  - Solar salt: 3

- If models to characterize the phenomenon have been already implemented in melcor fusion and the related version: YES:
  - MELCOR 1.8.2 allows He and air as a working fluid [2]
  - MELCOR 1.8.5 allows Helium, Hydrogen, FLiBe, Lithium, Nitrogen, LiPb, etc [3]
  - MELCOR 1.8.6 allows Helium, LiPb [12] and being a development of MELCOR 1.8.5 allow also Hydrogen, FLiBe, Lithium, Nitrogen

ISSUE N. 2: USE OF DIFFERENT FLUIDS IN DIFFERENT CIRCUITS

- Description of phenomenon of interest or issue to be addressed
  - Implementation of the possibility to use different fluids in different circuits at the same time during the calculation:
    - Lithium/H_2O,
    - PbLi/H2O,
    - PbLi/He,
    - He/H2O
    - CO2/FLiNaK
    - FLiBe/FLiNak
    - Pb/Wate

- Safety relevance of the phenomenon for fusion reactor
  - For safety analyses, it is important to model scenarios involving different working fluids in different circuits at the same time.
  - These different fluids can interact (mixing, chemical reaction, ..) during a postulated transient progression. This feature can be useful for HCLL, WCLL, Dual Coolant Lithium Lead breeding Blanket (DCLL) and Helium-cooled pebble bed breeding blanket (HCPB) safety analyses.
  - The current methodology suggested by INL with MELCOR 1.8.6 Fusion is to define two different inputs, one for each different working fluids, and parallelize the calculation in order to simulate, for example, the blowdowns.

ISSUE N. 2: USE OF DIFFERENT FLUIDS IN DIFFERENT CIRCUITS

- **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 3

- **If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:** NO

ISSUE N. 3: CHEMICAL REACTIONS IN THE CASE OF DIFFERENT WORKING FLUIDS

- Description of phenomenon of interest or issue to be addressed
  - Introduce models for chemical reactions in the case of different working fluids

- Safety relevance of the phenomenon for fusion reactor
  - In a safety analysis involving the Breading Blanket (BB), it is important to model chemical reactions (such as Lithium and/or LiPb: reaction with water and reaction with air) between different working fluids.
  - Chemical reactions, e.g. involving lithium, could be exothermic and generate H2 and other gases/aerosols.
    - For an example in the case of the VV LOCA involving Water and LiPb some oxidations, H2 and other gases/aerosols production can occur.

- Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development: 2

- If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version

  PARTIALLY:
  Lithium-air reaction model is implemented in MELCOR fusion [5,6]
  Lithium – H2O is not implemented [13]

ISSUE N. 4: STEAM OXIDATION OF THE PLASMA-FACING-COMPONENT (PFC)

- **Description of phenomenon of interest or issue to be addressed:**
  - Model steam oxidation of the PFC.

- **Safety relevance of the phenomenon for fusion reactor**
  - During a blowdown transient, due to one or more breaks, steam can interact with PFC materials as:
    - Be (strongly exotermic reaction);
    - W (middle exotermic reaction);
    - C (endothermic reaction).
  - A LOCA transient in the VV determines Hydrogen production.
  - If a simultaneous LOVA occurs, there is the risk of hydrogen explosion due to free oxygen presence in air.
  - This could determines the mobilization of radioactive dust and release of tritium and Activated Corrosion Products (ACPs).

ISSUE N. 4: STEAM OXIDATION OF THE PLASMA-FACING-COMPONENT (PFC)

- **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 2

- **If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:**

  YES:

  Modifications to model the oxidation of PFC material in presence of steam (v1.8.2) [1,3]

ISSUE 5: AIR OXIDATION OF THE PLASMA-FACING-COMPONENT

- Description of phenomenon of interest or issue to be addressed:
  - Model air oxidation of the PFC.

- Safety relevance of the phenomenon for fusion reactor
  - Due to a LOVA, air can go inside the VV and can interact with PFC materials as Be, W, C.
  - This determines material oxidation and energy production.
  - Since it is due to a LOVA, this phenomenon could be coupled with a release of radioactive material.

- Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development: 2

- If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version

  YES:
  - Modifications to model the oxidation of PFC material in presence of air (v1.8.2) [4]

ISSUE N. 6: AEROSOLS TURBOLENT AND INERTIAL DEPOSITION

- Description of phenomenon of interest or issue to be addressed
  - Introduce models for aerosols turbolent and inertial aerosol deposition

- Safety relevance of the phenomenon for fusion reactor
  - This is relevant because can influence the release of radioactive products.

- Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development: 2

- If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:

  YES:
  - Improvements made in v1.8.2 on aerosol deposition model: two additional mechanisms added (i.e., turbulent and inertial deposition) [2]

ISSUE N. 7: AEROSOLS DEPOSITION WITH DIFFERENT CARRYING GAS AND MIXTURES

- Description of phenomenon of interest or issue to be addressed
  - Extend the MAEROS models to account for aerosols deposition with different carrying gas and mixtures

- Safety relevance of the phenomenon for fusion reactor
  - This is relevant because can influence the release of radioactive products.

Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development: 2

- If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version

  YES:
  - Improvements made in v1.8.2 on aerosol deposition model: different carrier gas (e.g., air, steam, helium,...,mixtures) [2]

ISSUE N. 8: AEROSOL RESUSPENSION

- Description of phenomenon of interest or issue to be addressed
  - Adapt the implemented aerosol resuspension model.

- Safety relevance of the phenomenon for fusion reactor
  - The erosion of the PFC components generate dust that can be mobilized again due to resuspension during a transient progression (LOCA and LOVA).
  - This is relevant because can influence the release of radioactive products.
  - The model has to be assessed against the conditions expected in fusion devices. Two or more models might be also introduced to have a better reproduction of resuspension at low pressure (order of few kPa) and at high pressure (order of >100 kPa).

- Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development: 2

- If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version

  YES:

  - Improvements made in v1.8.5 on aerosol deposition model [9]: two models has been implemented
    - Vainshtein resuspension model;
    - Reeks and Hall → Rock 'n Roll resuspension model

ISSUE N. 9: EXTEND THE DEPOSITION AND RESUSPENSION MODELLING TO TAKE INTO ACCOUNT REMNANT MAGNETIZATION EFFECTS

- ❑ **Description of phenomenon of interest or issue to be addressed**
  - o Extend the deposition and resuspension modelling to take into account remnant magnetization effects.

Safety relevance of the phenomenon for fusion reactor

- o The structural materials and the dust generated through the erosion of the PFC components might have a remnant magnetization after sitting in a magnetic field for some time.
- o This is phenomena might introduce a new phenomenon that has to be taken into account for deposition and resuspension.

- ❑ **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 1

- ❑ **If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:** NO

ISSUE N. 10: AEROSOLS TRANSPORT IN MULTIFLUID

- **Description of phenomenon of interest or issue to be addressed**
  - Introduce models for aerosols transport in multifluid (multi-working fluid) simulation.

Safety relevance of the phenomenon for fusion reactor

- In a transient progression involving the BB it is important to model aerosol transport in different working fluids.

  For an example in the case of the VV LOCA, involving Water and LiPb, resuspension of dust and lithium lead vapors and droplets can occur.

- This is relevant because can determine the release of radioactive products.
- MELCOR 2.2 shall introduce these phenomena models depending on the TH boundary conditions simulated during the scenario in order to cover the transport of the dust and ACPs in presence of more than one working fluids.

- **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 2
- **If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:** NO

ISSUE N. 11: HEAT TRANSFER CORRELATIONS FOR HE

- Description of phenomenon of interest or issue to be addressed
  - Implementation of specific heat transfer correlations for simulating He as working fluid in the geometry of interest.

- Safety relevance of the phenomenon for fusion reactor
  - Dittus-Boelter correlation, for forced convection, could not be accurate enough in some conditions and geometry.
  - In the case of codes, such as TRACE and RELAP5-3D, other correlations have been implemented in order to improve the accuracy of the calculated results (e.g. Gnielinski correlation [1][8], etc).
  - The applicability of such correlations outside the standard pressure (e.g. below the atmosphere pressure) has to be verified.

- Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development: 2

- If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version: NO

ISSUE N. 12: SCRUBBER MODEL FOR HELIUM

- **Description of phenomenon of interest or issue to be addressed**
  - Standard Scrubber model in FL Package for Helium.
- **Safety relevance of the phenomenon for fusion reactor**
  - Such model is done for simulating steam/water containing aerosol although it is interesting to benchmark the accuracy in the case of Helium. Such model can be used for simulating the wash phenomenon of the activated product and tritium combination with water inside the suppression pool into the Vacuum Vessel Pressure Suppressor System (VVPSS).
- **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 1
- **If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:** YES:

It exists in MELCOR 1.8.6 Fusion [17]
(FL package -→ **FLnnn02** – Flow path junction switches IBUBF= 1
TO BE VERIFIED for other fluids)

ISSUE N. 13: DISSOLVED NCG SPECIES WITHIN WORKING FLUIDS

- **Description of phenomenon of interest or issue to be addressed**
  - Introduce dissolved Non Condensable Gas (NCG) species within working fluids
- **Safety relevance of the phenomenon for fusion reactor**
  - Tritium is a relevant radio-isotope and exists in a dissolved state within many working fluids (e.g. LiPb) and cannot be represented by a NCG or aerosol, as the gas can be transported within a working fluid and later released without transport of a NCG species
  - A release of liquid LiPb (only) would not also provide a release of tritium in current models
- **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 2
- **If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:** No

ISSUE N. 14: MAGNETIC PUMP

- **Description of phenomenon of interest or issue to be addressed**
  - Implement magnetic pump modelling (for design) and features (e.g. coast-down, etc)

- **Safety relevance of the phenomenon for fusion reactor:** Low

- **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 1

- **If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:** No

ISSUE N. 15: MHD EFFECTS ON HEAT TRANSFER AND PRESSURE DROP

- **Description of phenomenon of interest or issue to be addressed**
  - Include MHD effects on heat transfer correlation and pressure drop evaluation (for design)

- **Safety relevance of the phenomenon for fusion reactor**
  - Magnetic fields are captured in the Hartmann number of a fluid and affects heat transfer and pressure drop.
  - This is a design issue and not safety issue.

- **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 1

- **If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:** No

ISSUE N. 16: EXTEND THE WATER PROPERTIES

- Description of phenomenon of interest or issue to be addressed:
  - Extend the water properties below triple point temperature

- Safety relevance of the phenomenon for fusion reactor
  - Freezing of water entering into the cryostat.
  - Cryogenic temperature implementation could be useful for safety analysis considering the water freezing in the cryostat.

    Example is a LOCA transient evolution in the cryostat.

- Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development: 2

- If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version: YES:
  - Modifications made in v1.8.2 in three areas: EOS, transport properties, and ice film buildup on HS [2]
  - Freezing film model (v1.8.2) [2][5]

ISSUE N. 17: AIR CONDENSATION ONTO CRYOGENIC STRUCTURES

- Description of phenomenon of interest or issue to be addressed:
  - Air condensation onto cryogenic structures

- Safety relevance of the phenomenon for fusion reactor
  - Air ingress into cryostat during an accident progression➔ condense and freeze
  - Cryogenic temperature implementation could be useful for cryostat safety analysis considering the air condensation in the cryostat.
  - This could take place during a LOVA in the cryostat.

- Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development: 2

- If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version: YES [14]:

  Modification to model the air condensation (v1.8.2) [3]

ISSUE N. 18: HELIUM CONDENSATION ONTO CRYOGENIC STRUCTURES

- ❑ Description of phenomenon of interest or issue to be addressed:
  - o Helium condensation onto cryogenic structures

- ❑ Safety relevance of the phenomenon for fusion reactor
  - o This is important to simulate a LOCA transient in the helium superconductor cooling circuit

- ❑ Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development: 2

- ❑ If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version: YES
  - o Already implemented in v 1.8.2 [2]

ISSUE N. 19: LOW TEMPERATURE OPERATIONS (>3K) AND CRYOGEN WORKING FLUIDS

- **Description of phenomenon of interest or issue to be addressed:**
  - Allow low temperature operations (>3K) and cryogen working fluids

- **Safety relevance of the phenomenon for fusion reactor**
  - Magnet systems present overpressure risks due to superconductor quench events, leading to rapid boiling of helium or nitrogen cryogen. Cryostat safety can be compromised by massive helium or nitrogen ingress during a quench event.
  - Cryostat safety can be compromised by massive helium or nitrogen ingress during a quench event.
- **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 2

- **If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version:** YES

  Present in MELCOR 1.8.6

ISSUE N. 20: EXTEND MATERIAL PHYSICAL PROPERTIES TO CRYOGENIC RANGE

- **Description of phenomenon of interest or issue to be addressed:**
  - Extend material physical properties to cryogenic range

- **Safety relevance of the phenomenon for fusion reactor**
  - Since MELCOR for fusion handles cryo cooling, it is necessary to extend the range of material properties of the cryo fluids and the construction materials accordingly

- **Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:** 3

- **if models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version**

  Partially in MELCOR 1.8.5

ISSUE N. 21: ENCLOSURE RADIANT HEAT TRANSFER

- Description of phenomenon of interest or issue to be addressed:
  - Enclosure radiant heat transfer.

- Safety relevance of the phenomenon for fusion reactor
  - Radiant heat transfer important due to high temperatures and/or low vacuum pressure.
  - The temperature of the first wall determine the amount of oxidation with steam and the consequent hydrogen production.

- Rank of importance (1: low; 2: medium; 3: High) ==> priority for code development:

  2

- If models to characterize the phenomenon have been already implemented in MELCOR fusion and the related version: Yes:

  Thermal radiation transport model [2]

CONCLUSIONS

- As action of the EMUG 2018, ENEA contacted all the EMUG Partner involved in Fusion related activity to collect the information about physical models necessary to be implemented in MELCOR_2.2 for fusion reactor safety analyses and the current model already implemented in MELCOR fusion.
- A common release MELCOR 2.x incl. fusion features is considered important from the code developer (only one MELCOR version for LWR, non LWR, Fusion) and code user point of view;
- It is recommended to build one MELCOR release for fission and fusion in future;
- In relation to SNAP, It is to underline also that Input deck of MELCOR1.8.6 for fusion cannot be read in SNAP (already used for USNRC code as applied for MELCOR2.2, RELAP, TRACE) which impedes model extension to large number of BB modules.
- Some internal discussion between the co-authors is still in progress in relation to the issues related to
  - Hydrogen tritium oxide transport;
  - Tritium transport;
  - Dust and Hydrogen explosion;
- All the phenomena/processes have been ranked;
- A report has been prepared in a draft form and soon will be released to all the EMUG Partners

GRAZIE PER LA VOSTRA ATTENZIONE

ABBREVIATIONS

ACP	Activated Corrosion Product
BB	Breading Blanket
DCLL	Dual Coolant Lithium Lead breeding Blanket
EOS	Equation Of State
FLIBE	$LIF+BeF_2$ molten salt
HCLL	Helium-cooled Lithium Lead breeding blanket
HCPB	Helium-cooled pebble bed breeding blanket
HITEC	$KNO_3 + NaNO_2 + NaNO_3$ molten salt
IHTS	Intermediate Heat Transport System
LOCA	Loss of Coolant Accident
LOVA	Loss of Vacuum Accident
NCG	Non Condensable Gas
PFC	Plasma Facing Components
VV	Vaccum Vessel
VVPSS	Vacuum Vessel Pressure Suppressor System
WCLL	Water-Cooled Lead Lithium Breading Blanket

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