



ASTRE

Accessibility Simulation Tool for Radiological Emergency

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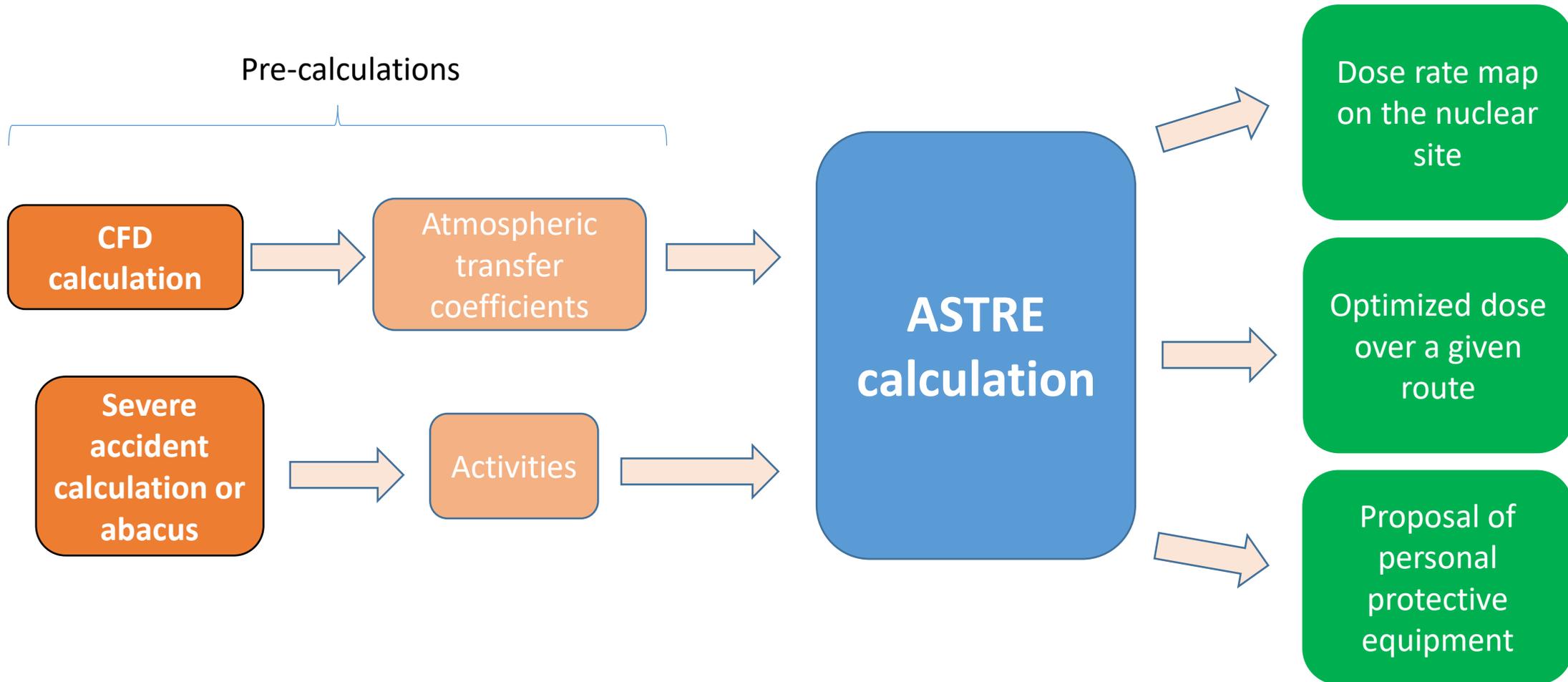
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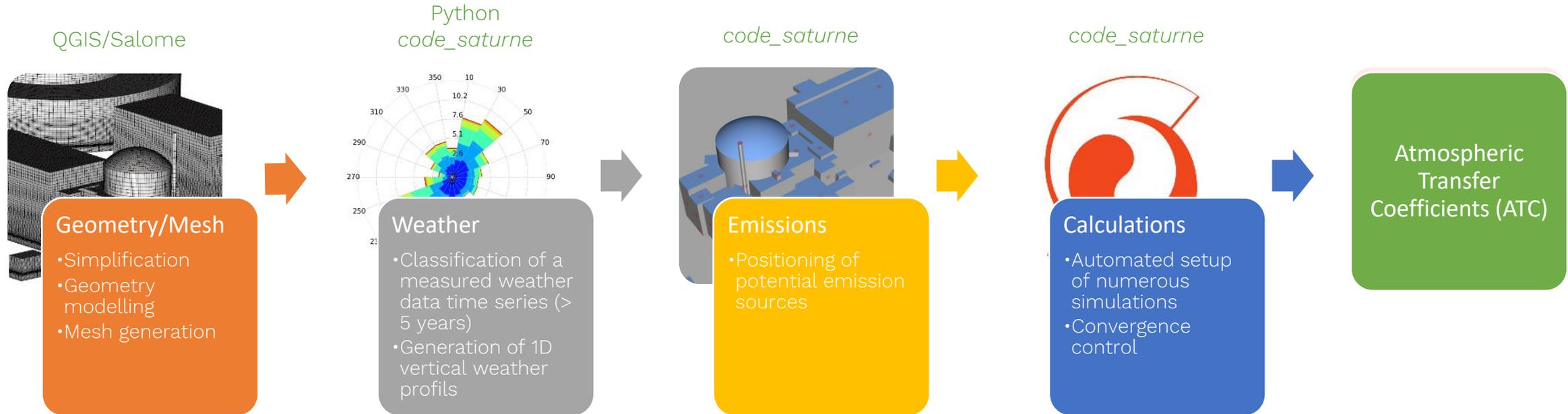
1. CONTEXT AND OBJECTIVE OF THE PROJECT

- Development of a tool at EDF R&D dedicated to the radiological emergency situations on the nuclear site
→ development of the ASTRE tool
- The main goals of ASTRE are to:
 - evaluate the radiological release on the nuclear site and inside some buildings
 - evaluate a realistic dosimetric prevision for the interventions of agents on the power plant in case of radiological emergency situations,
 - propose the personal protective equipment which would be useful during the intervention,
 - evaluate the best path to minimize the dose rate/integrated dose as well as the contamination undergone during an intervention.

2. GENERAL ARCHITECTURE

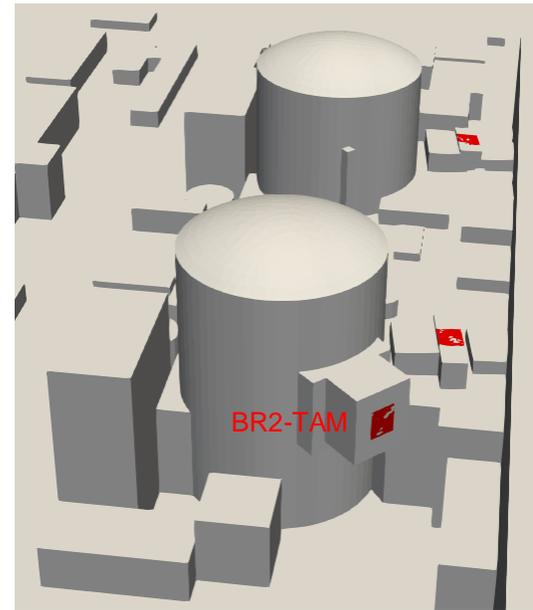
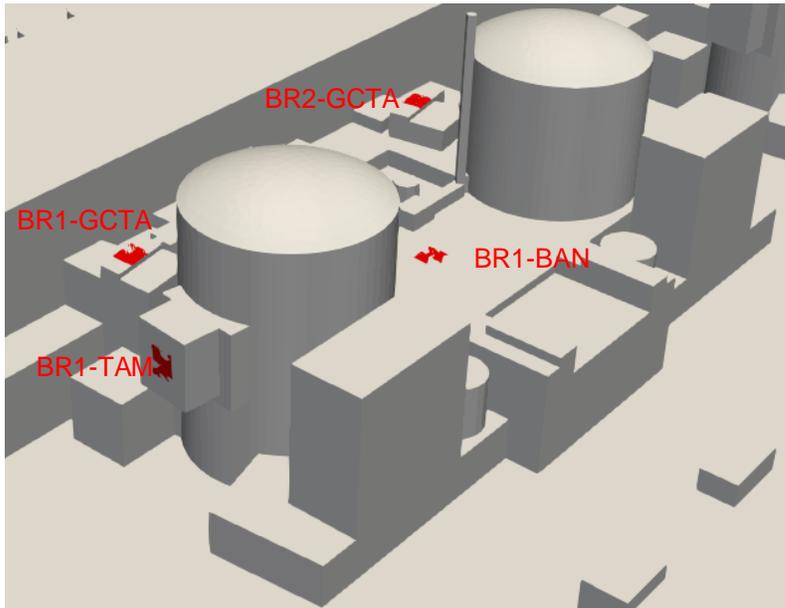


3.A. CFD SIMULATION USING CODE_SATURNE (1/2)



3.A. CFD SIMULATION USING CODE_SATURNE (2/2)

- Potential emission sources



Boundary faces representing emission sources in the vicinity of the reactor buildings « BR1 » and « BR2 ».

3.B. ESTIMATION OF DOSIMETRIC QUANTITIES

- **Goal:** Estimate realistic dosimetric quantities (dose rate D_{ed} , integrated dose) during the accident

$$D_{ed}(t) = f(\text{ATC, RN activities})(t)$$

with

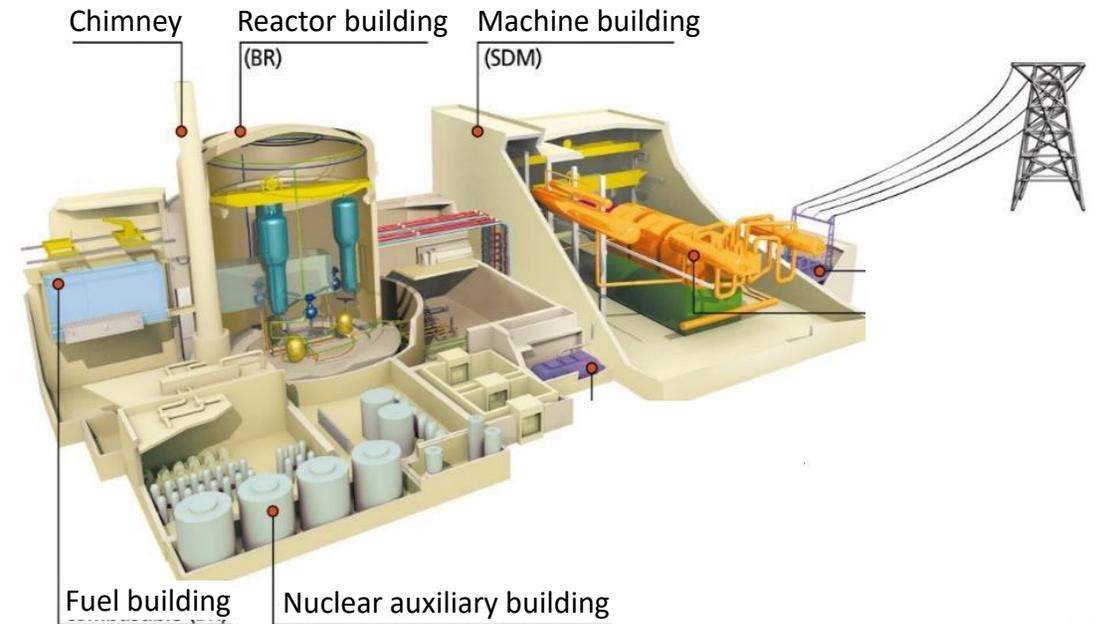
ATC: integration of the weather situation (i.e. thermal stratification of the atmosphere, direction and wind strength) – precalculations performed using code_saturne

RN activities: precalculations performed with a severe accident code or abacus

⇒ **Specific on-going studies to improve the estimation of RN activities to realistic values.**

3.C. DOSE RATE INSIDE BUILDINGS

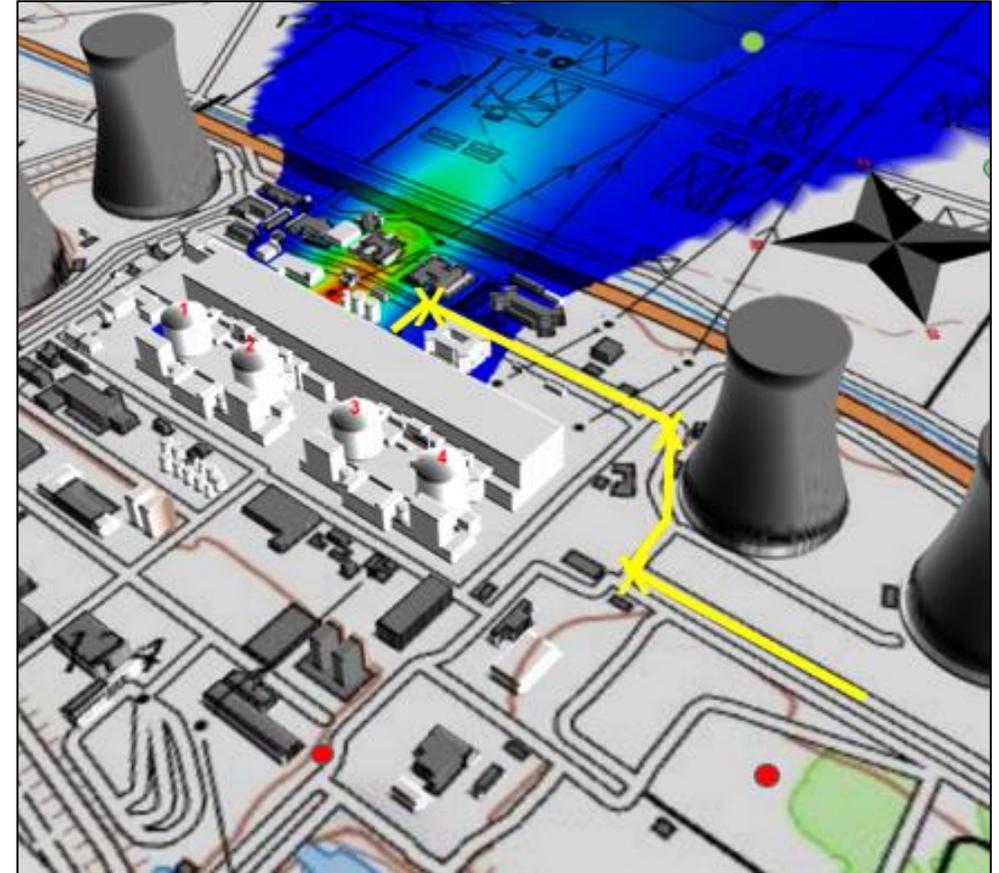
- Goal =
 - to estimate the dose rate in given locals of interest
- Proposed solutions:
 - Simplified model based on a zonal approach
 - More precise one, based on CFD calculations (code_saturne)
- **New and innovative solutions to be studied as from 2023.**



Overview of the main buildings of a nuclear reactor

3.D. DATA ASSIMILATION

- *Data assimilation is the technique whereby observation data (here on-site dose rate measurements) are combined with output from a numerical model to produce an optimal estimate of the evolution.*
- Data assimilation may be used to correct the dose rates calculated with ASTRE, using on-site dose rate measurements.
- It could be performed on a given path (too few data to correct the calculation on).
- Application to ASTRE will be studied as from 2023.



Path example

3.E. ASTRE INTERFACE

- Study of the ergonomics of the interface
- Very simple use
- Possibility to manually enter all the data
- Visualization on the site map

ASTRE Bonjour Jean Dupont

Paramètres de simulation

Localisation du rejet:
Tranche: 1 Bâtiment: BAN [BR]

Initiateur: APRP

Ouverture Filtre US: Oui

AES: En service

Ventilation: En service

Conditions météo

Phase (s): 6 Durée totale: 15h

Nom de la phase	Durée (h)	Direction vent	Dispersion
1 Phase initiale	2 h	58 °N	Classe A
2 Nom phase 2	Durée (h)	120 °N	Classe B
3 Nom phase 3	Durée (h)	46 °N	Classe B
4 Nom phase 4	Durée (h)	10 °N	Classe A

Balises

Nom balise	valeur
Nom balise 1	valeur
Nom balise 2	valeur
Nom balise 3	valeur
Nom balise 4	valeur
Nom balise 5	valeur
Nom balise 6	valeur
Nom balise 7	valeur
Nom balise 8	valeur
Nom balise 9	valeur
Nom balise 10	valeur
Nom balise 11	valeur
Nom balise 12	valeur

Accessability Simulation Tool for Radiological Emergency

Choix du CNPE: DAMPIERRE Tr1 TEM Tr2 AT Tr3 TEM Tr4 TEM

Choix de la visu: DDD IRRADIATION

Site: Dampierre Initiateur: APRP Filtre US: ON EAS: OFF Ventilation: ON Provenance: undefined Stabilité: classe undefined Validité Temporelle: 4.5 h

DeD (mSv/h) 9.960e+01 4.70e+01 2.980e+01 1.490e+01 1.000e+01

Cheminements

Parcours: 3

Visu	Nom du parcours	Distance (m)	DDD intégré
<input checked="" type="checkbox"/>	A Nom chemin A		0.00
<input type="checkbox"/>	B Nom chemin B		0.00
<input checked="" type="checkbox"/>	C Nom chemin C		0.00

Journal de Bord

- 04/06/20 15:06 ASTRE Evènement automatique issu de ASTRE
- 04/06/20 15:18 Jean Dupont Message saisi par Jean Dupont

3.F. USE CASE: FUKUSHIMA DAIICHI

- Simulation of the Fukushima Daiichi accident using ASTRE
- CFD simulation using code_saturne
- Weather and estimated source term taken into account
- Comparison of ASTRE results to on-site measured data



Geometry for the CFD calculation

4. CONCLUSIONS AND PERSPECTIVES

- ASTRE: new tool being developed at EDF R&D to evaluate the consequences on the nuclear site of a radiological emergency release.
- Following steps: Improvement of models \Rightarrow real R&D challenge !
 - dose rate evaluation inside the buildings
 - more realistic source term
 - use of on-site measurements during the accident
- At mid-term: first version of the tool to be tested by the end-users



Questions