PROSPETTIVE DI SIMULAZIONE INTEGRATA DEL SISTEMA ENERGETICO

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1.1 …. un simulatore ?

- Un ‘simulatore’ è in generale una complessa ‘macchina’ costituita da sistemi HW e SW che riesce a rappresentare con adeguata fedeltà il comportamento di … (esempi) …. Un aereo, un treno, un veicolo spaziale, un impianto nucleare…
- Ma gli obiettivi, le funzionalità, la accuratezza dei vari ‘tipi’ di simulatori possono essere molto diversi….

1.2 …. un simulatore per ‘training’ ?

- Un simulatore di addestramento è per :
  - A) replicare alla perfezione (o quasi) l’ambiente operativo (es. sala controllo, cabina di guida…)
  - B) addestrare operatori-piloti all’uso del sistema (impianto-veicolo…)
  - C) eventuali perfezionamenti delle procedure di utilizzo nelle varie condizioni operative

  - NB : in questo caso il ‘sistema’ non è modificabile dal normale utente finale, ma solo dagli esperti HW e SW

Training Simulator Example

Simulatore di addestramento : replica di Sala Controllo (per la gestione del sistema)

1.3 …. O un simulatore 'ingegneristico'

Un simulatore di 'ingegneria' è per:

- Analisi e verifiche di progetto per i nuovi impianti
- Sviluppo del progetto di sistema/impianto….
- Collaudo e verifica del sistema di protezione e controllo, o altri sottosistemi
- Pre - addestramento operatori – piloti – utenti
- Verifica e validazione delle procedure operative in condizioni di impianto normali ed incidentali

>>>> obiettivo la progettazione del sistema

ENEA-Westinghouse Engineering Simulator

La consolle di ES-1000 – ENEA Casaccia - 1986

SIMULATORE INGEGNERISTICO attuale

NUTEMA Knowledge Management and Simulation System at S. Piero a Grado (Pisa Univ)

2. The Energy System

MAIN COMPONENTS :

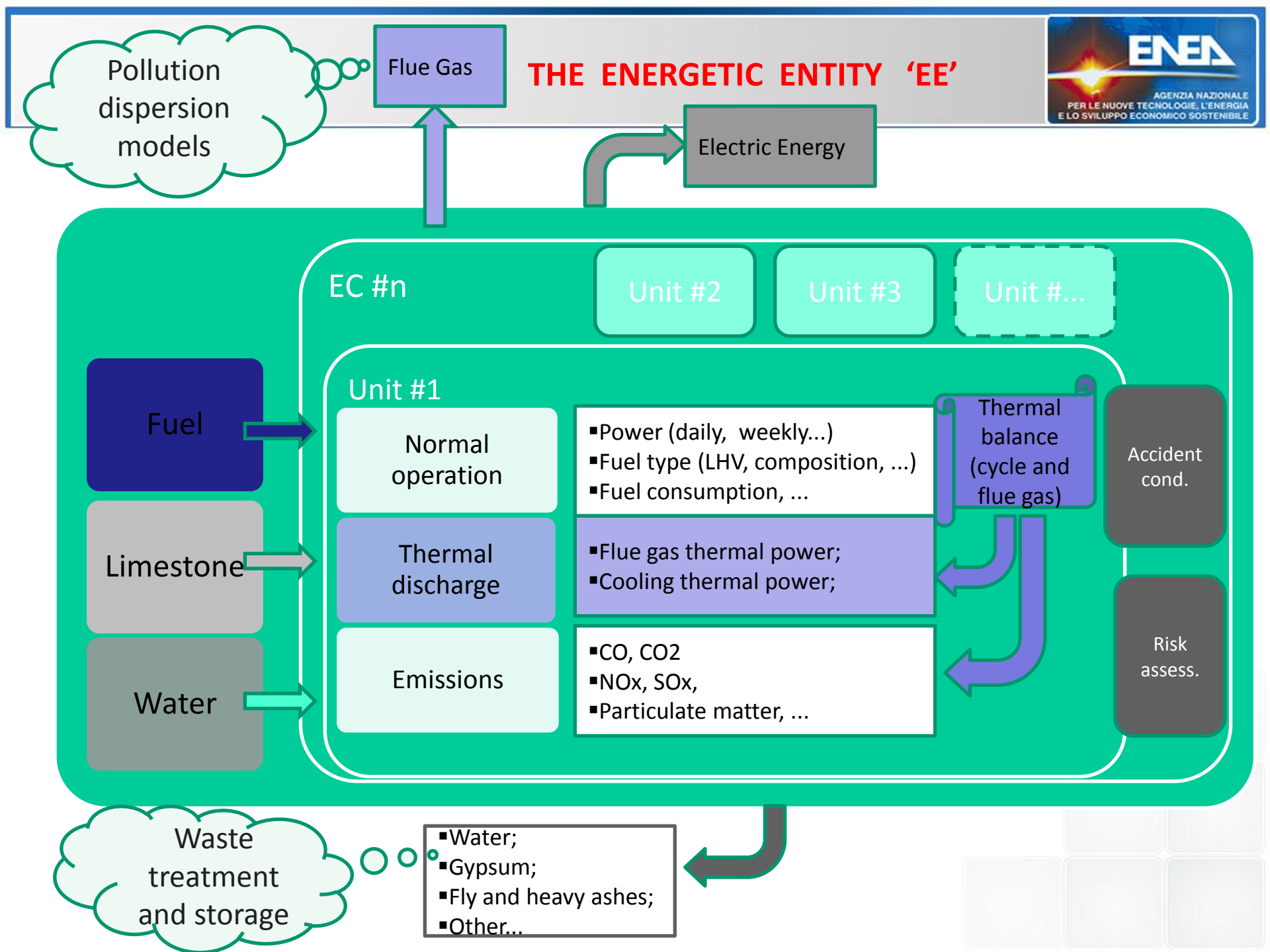
- Energy (and fuels) production plants
- Transmission&Distribution – Transport Networks (of electricity – gas – liquid fuels…)
- Energy users (Multimodal Transportation system Road-rail-water-air ; residential ; industrial system….)

The Energy System COMPONENTS

3. Ideas for Simulating the ES

- BASIC simulation concepts being developed:
  - The Energetic Entities
  - The operating conditions
  - Use of a GIS
  - Three risk types and their categorisation
  - The three Macro ‘Applications’
  - The Time variable
  - A possible project architecture

THE ENERGETIC ENTITY 'EE'



3.1 The Operating Conditions

- OC1 - Normal Operation (w variable level of Power produced-transported-used)
- OC2 - Abnormal Operation : malfunctions/small accidents creating local disturbance: no significant added effect on environment or population
- OC3 - Accidental condition, caused by a relevant breakdown-failure affecting not-negligible-significant parts of the production-transport-usage system

3.2 Energy Entities and GIS

- All the simulated entities will be geo-referenced by using a largely used commercial GIS. This will allow to operate the simulations with the most fitted spatial resolutions, and to 'localize' the impacts of the energetic system, in order to quantify in a credible and systematic way the Sustainability of the System itself.
- The energetic entities (production plants, transmission lines, 'sinks' such as energy consumers) could be represented in the GIS by 'standard icons' having dimensions proportional to the main operational parameters (e.g. Output Electric Power for an Electricity Production Plant, or Energy Consumption for the Sinks). Behind these icons a number of simplified software models will run for each type of entity (in general, for the case of large scale simulators covering Countries or the whole EU)

3.3 Tre fonti di rischio

- The whole energy system, parts of it or a single EE have in common three key 'enemies'
  - A) SAFETY ISSUES (**troubles created primarily by technical internal breakdowns**…
  - B) SECURITY ISSUES (**problems created primarily by malicious/crazy human actions** …)
  - C) EXTREME NATURAL EVENTS (**small or major troubles originated primarily by the force of Nature** …)

ALL THESE 'ISSUES' WILL HAVE TO BE CATEGORIZED AND THEIR EFFECT ON THE EEs OPERATING CONDITION WELL DEFINED :

Example : the emission of pollutants of a production unit can depend on the unit conditions created by an adverse events

3.4 tre Macro Applicazioni

Energy System Simulators (ESS) can be developed aiming at three different 'macro' applications

- A) Sustainable Planning of the Energy System in the years to come (a planning tool) : step 1 (fastest to be done)
- B) Design of the actions/measures to be taken for tackling anomalies and accidents (safety and security aspects) including extreme natural events (floodings, hurricanes, tsunamis…)
- C) System management in anomalous and-or emergency conditions (also with use of real time data coming from the territory) : the most difficult 'app' … will come later… final users to be identified after care analysis of possibilities

3.5 the TIME variable

- The ‘time’ variable will be used in a **flexible way** as a function of the type of analysis to realize : real time , or with time-steps **from hours**, days, weeks….. **to years**.
- This flexiblity will allow to analyze **‘with the due slowliness’ particular scenarios to be deepened** in detail. Runs in ‘real time’ will deal with situations in which it is important to verify the response of the operators of the energy system and-or of various sub-systems.
- **Longer time steps are needed to study policies in the short, medium and long period**, when the dominating concern is the overall evolution of the energy system and the reaching of target policy objectives (e.g. the targets of reduction of consumptions and CO2 emissions by reference years).

3.6 A proposal frame (SPES - 2015)