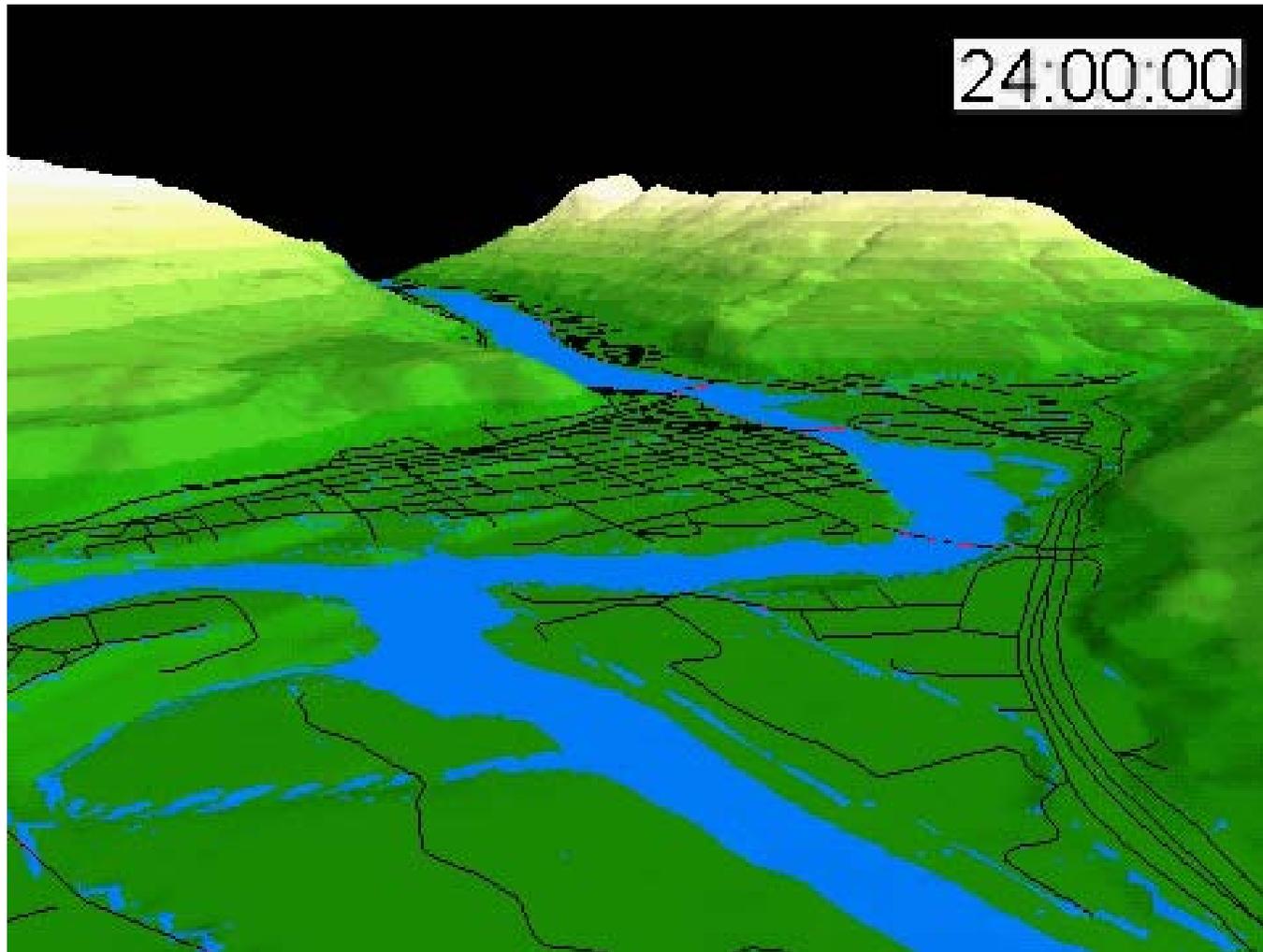
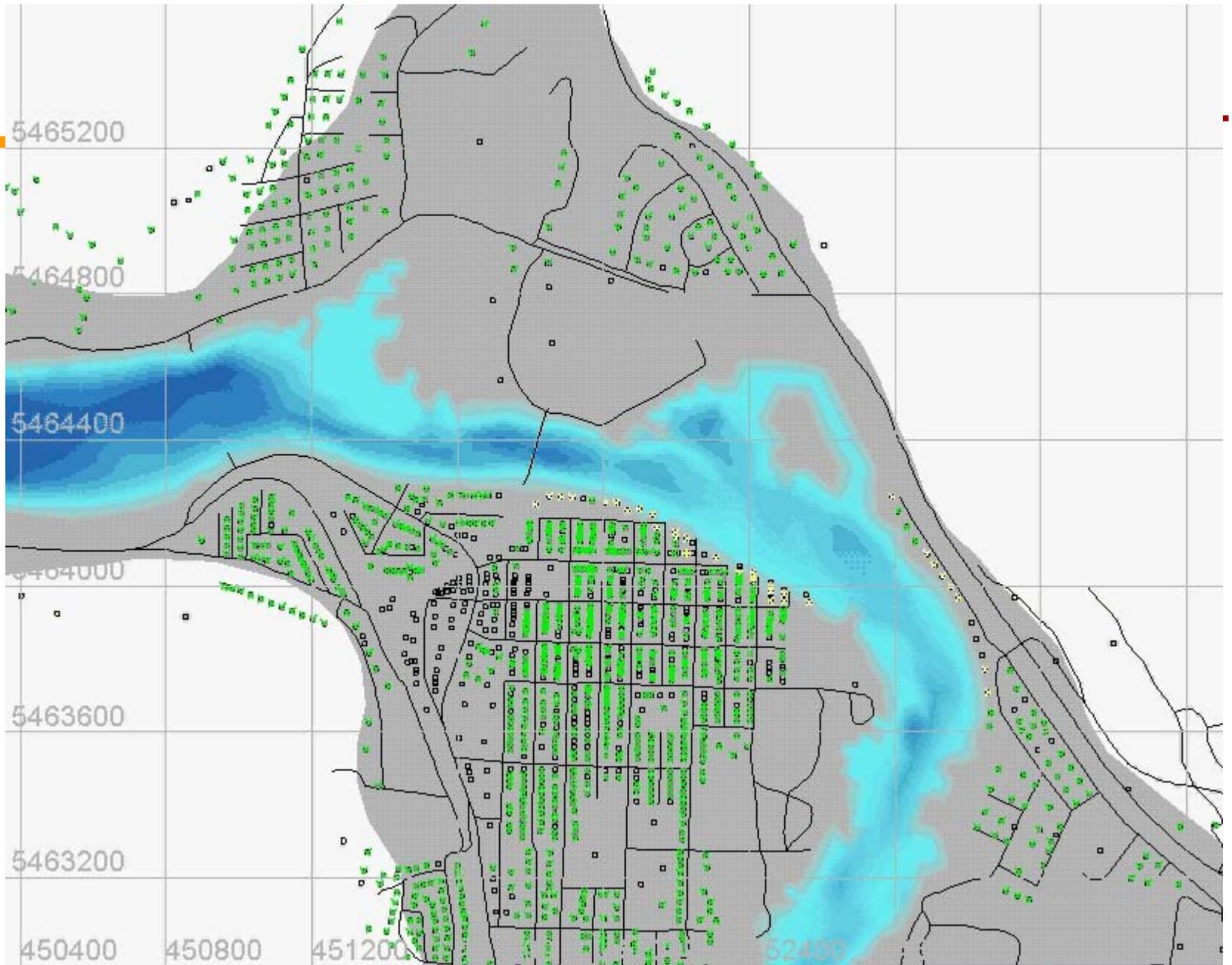

Physical Modelling of Dam Failure

Consequences in Virtual Reality

The Life Safety Model Approach

Inundation animation





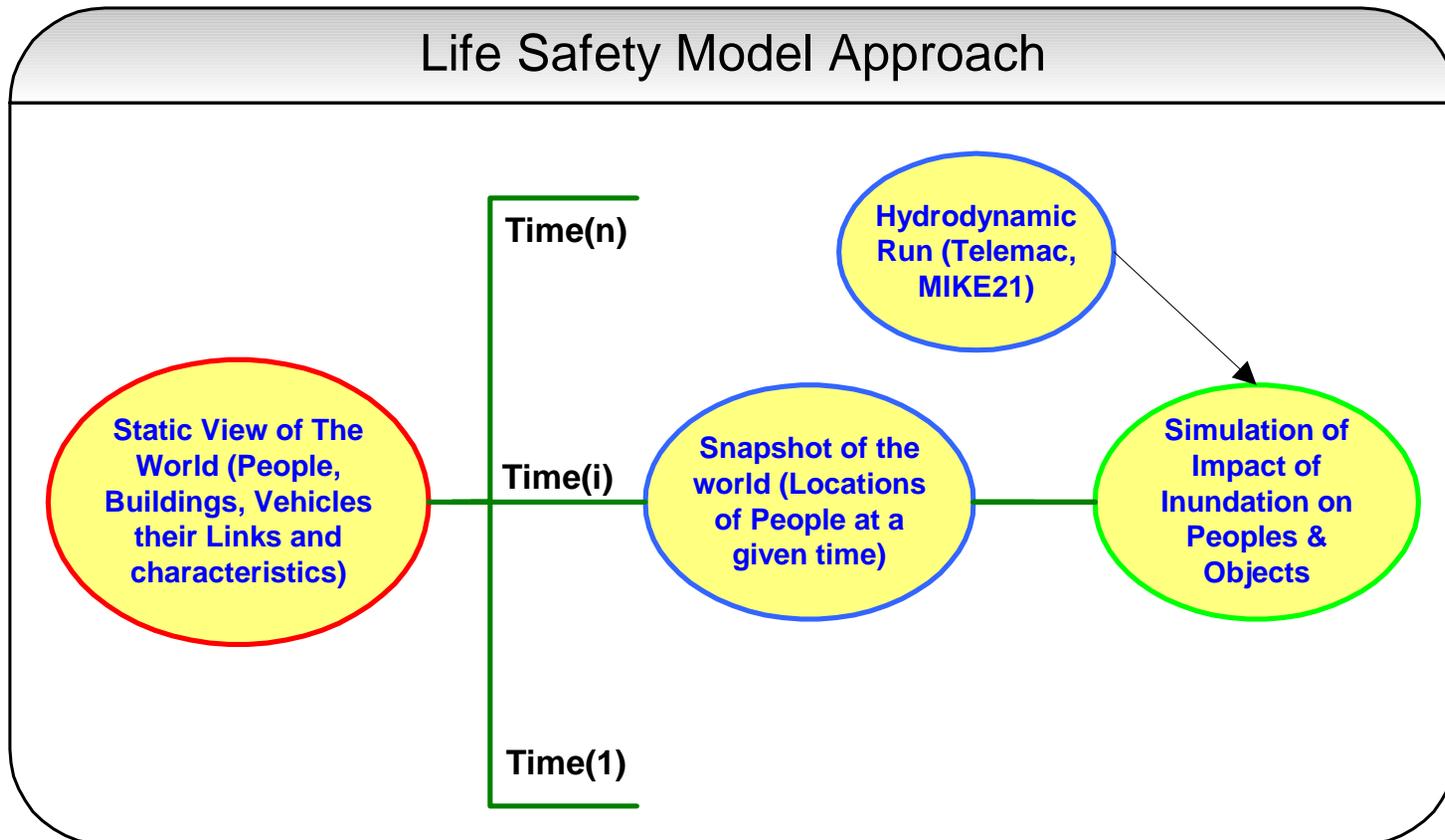
Virtual Approach

- ◆ **Create a virtual dam mass emergency that:**
 - is a spatio-temporal integrated representation of flood propagation and human communities;
 - can be viewed, analyzed and recreated in a flexible and intuitive way; and
 - can be assembled automatically based on available census and GIS data, or created directly by the user.

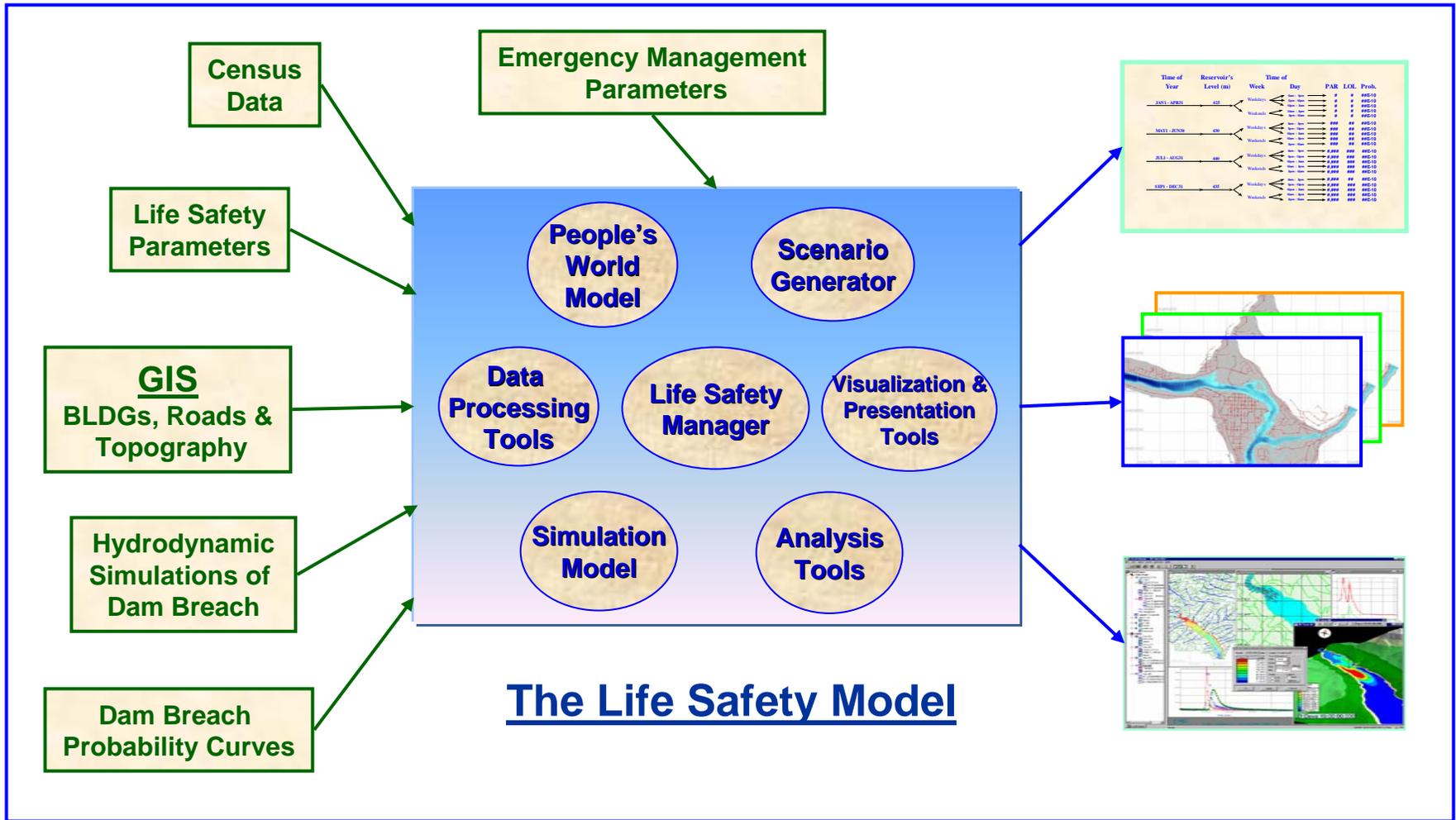
The Life Safety Model: Views of the World

- ◆ In the LSM, the world is viewed from two perspectives:
 - A static view which represents long-term characteristics of and links among people and material objects (buildings, vehicles, etc..). For example, age, sex, family ties, place of residence and work.
 - A dynamic view which represents a snapshot of the world at a given time of day, week and year.

The Life Safety Model Approach: Generation of Scenarios



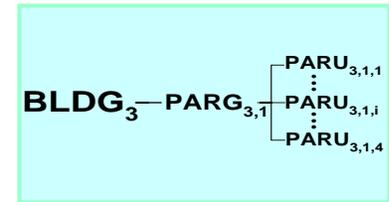
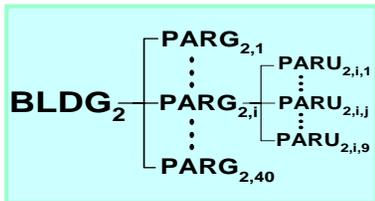
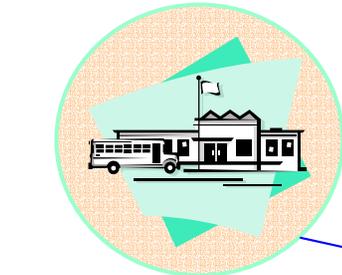
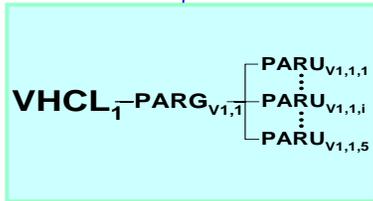
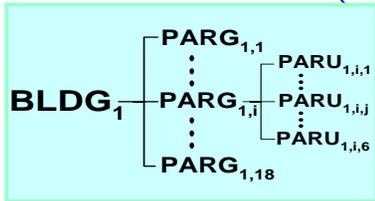
Life Safety Model: Architecture



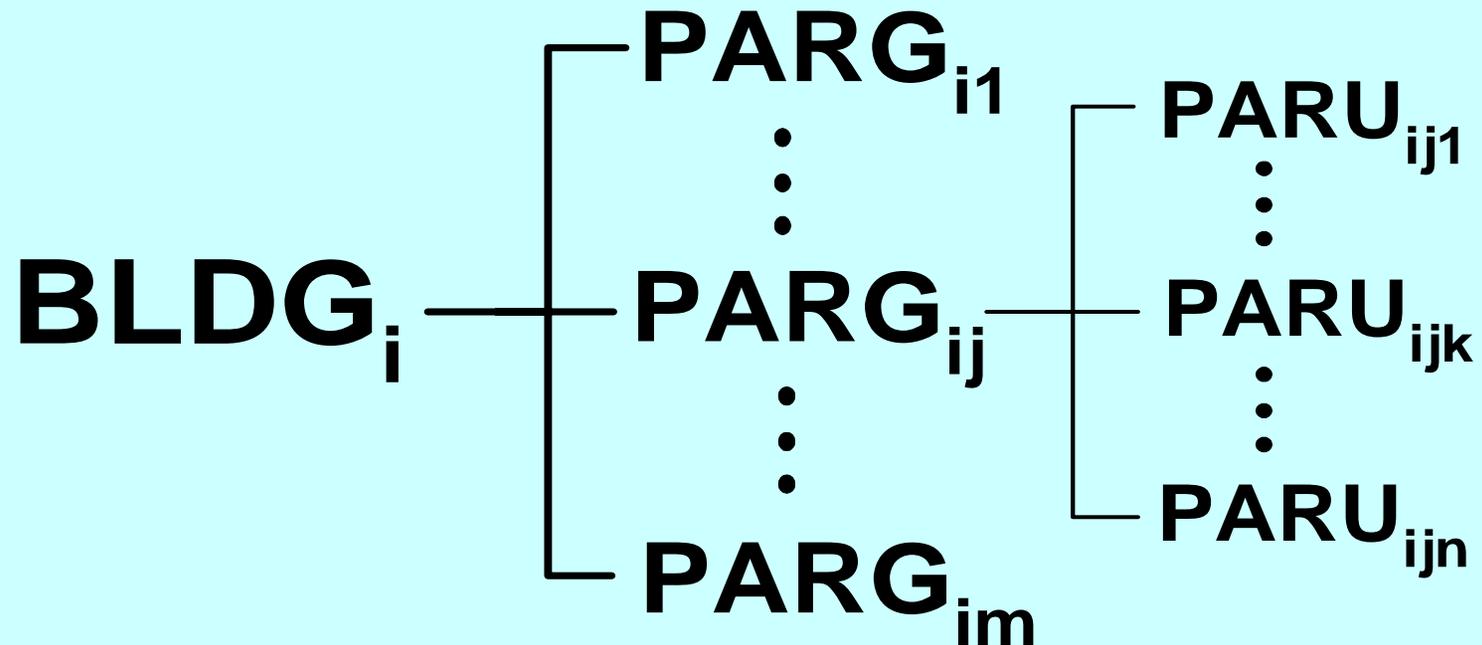
Generating Snapshot Views



Time: 8am - 5pm
 Day: Monday - Friday
 Month: April 1- May 31



Hierarchy of LSM Objects



BLDG = Building

PARG = Population at Risk Group

PARU = Population at Risk Unit

Life Safety Simulation Model: Representation of a Virtual World

- ◆ PARUs are assigned parameters that dictate their behaviour, movement, stability and chances of surviving the emergency.
- ◆ Impact of some non-hydraulic hazards (e.g. hypothermia) is simulated. Design is flexible to incorporate other hazards (e.g., fire, debris).
- ◆ PARUs are grouped into PARGs to capture collective behaviour.

Life Safety Simulation Model: Representation of a Virtual World

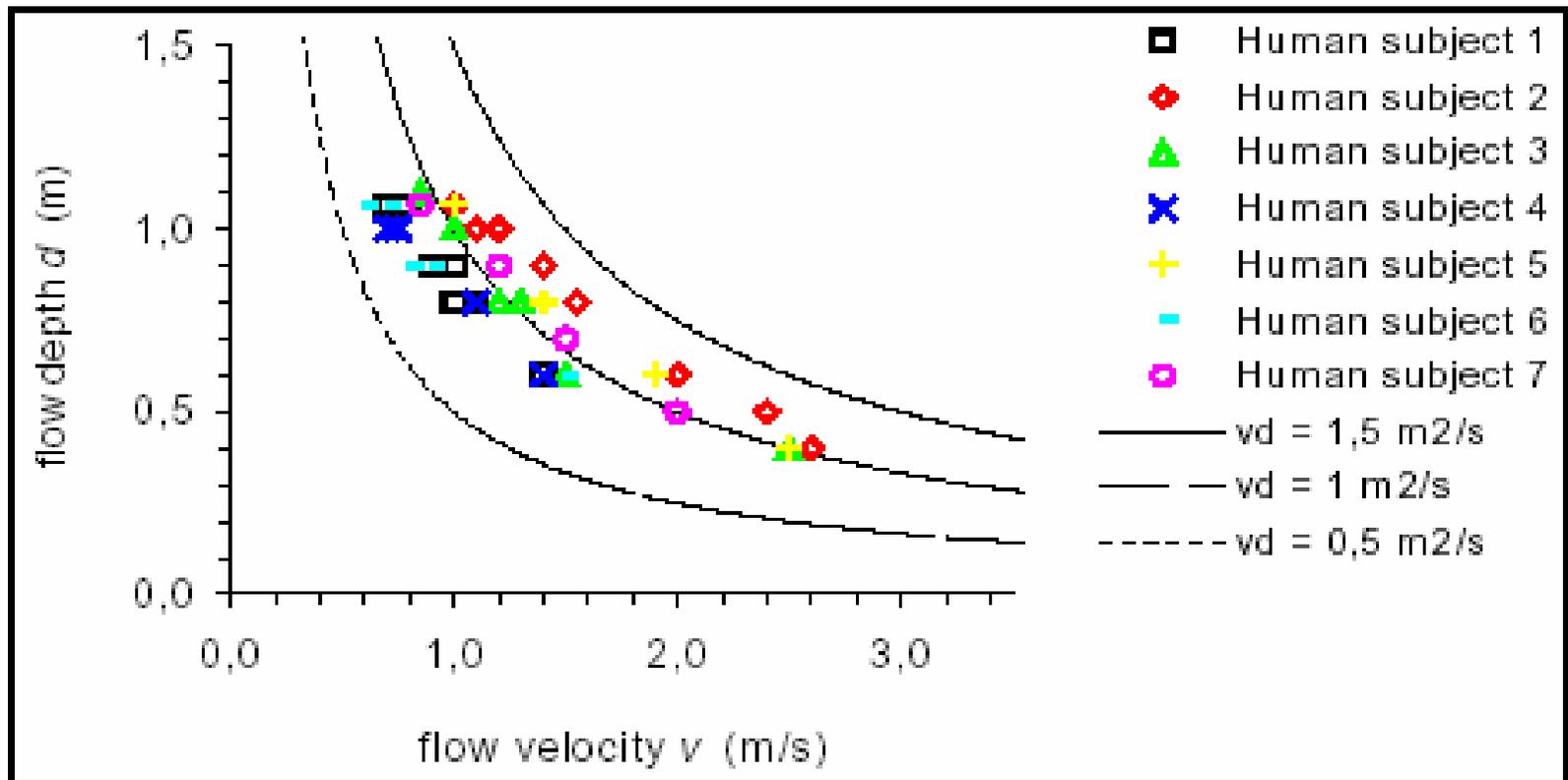
- ◆ Individual-based traffic simulation.
- ◆ Simulation of warning systems.
- ◆ Ability to impose events (e.g. closing roads).
- ◆ Stability of PARUs, buildings, vehicles are calibrated based on analytical models and laboratory data: Lind et al. (1999), RESCDAM (2000), Abt (1989) & Black (1975).

Modelling Data: Human Stability Experiments



[Ref.: "RESCDAM Final Report", Helsinki University Of Technology \(Dec. 2000\)](#)

Modelling Data: Human Stability Experiments



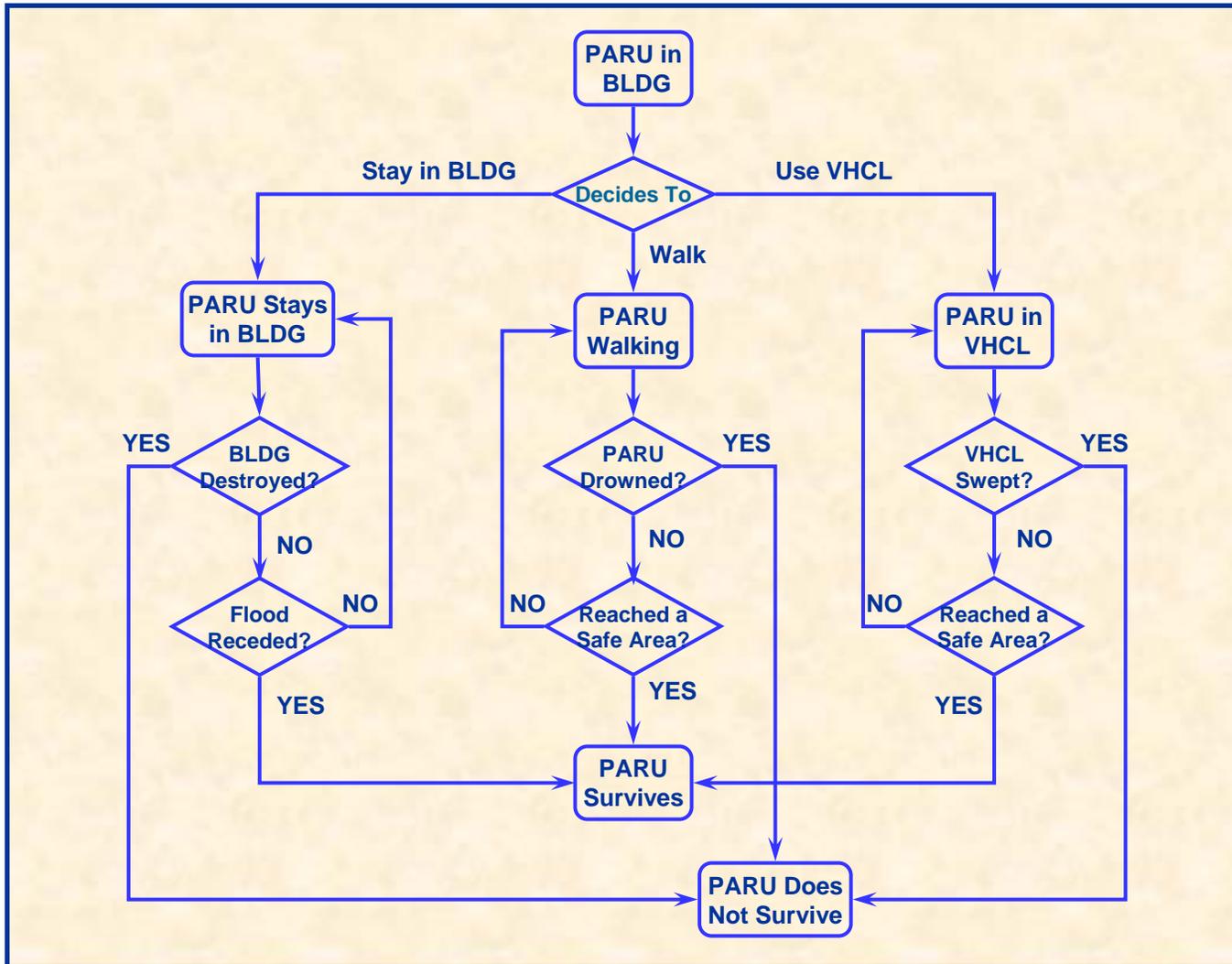
Ref.: "RESCDAM Final Report", Helsinki University Of Technology (Dec. 2000)

Modelling Data: Structure Reliability Experiments



[Ref.: "RESCDAM Final Report", Helsinki University Of Technology \(Dec. 2000\)](#)

Life Safety Simulation Model: Algorithm Overview



Testing

Simulation of Malpasset Dam Failure
France, 1959

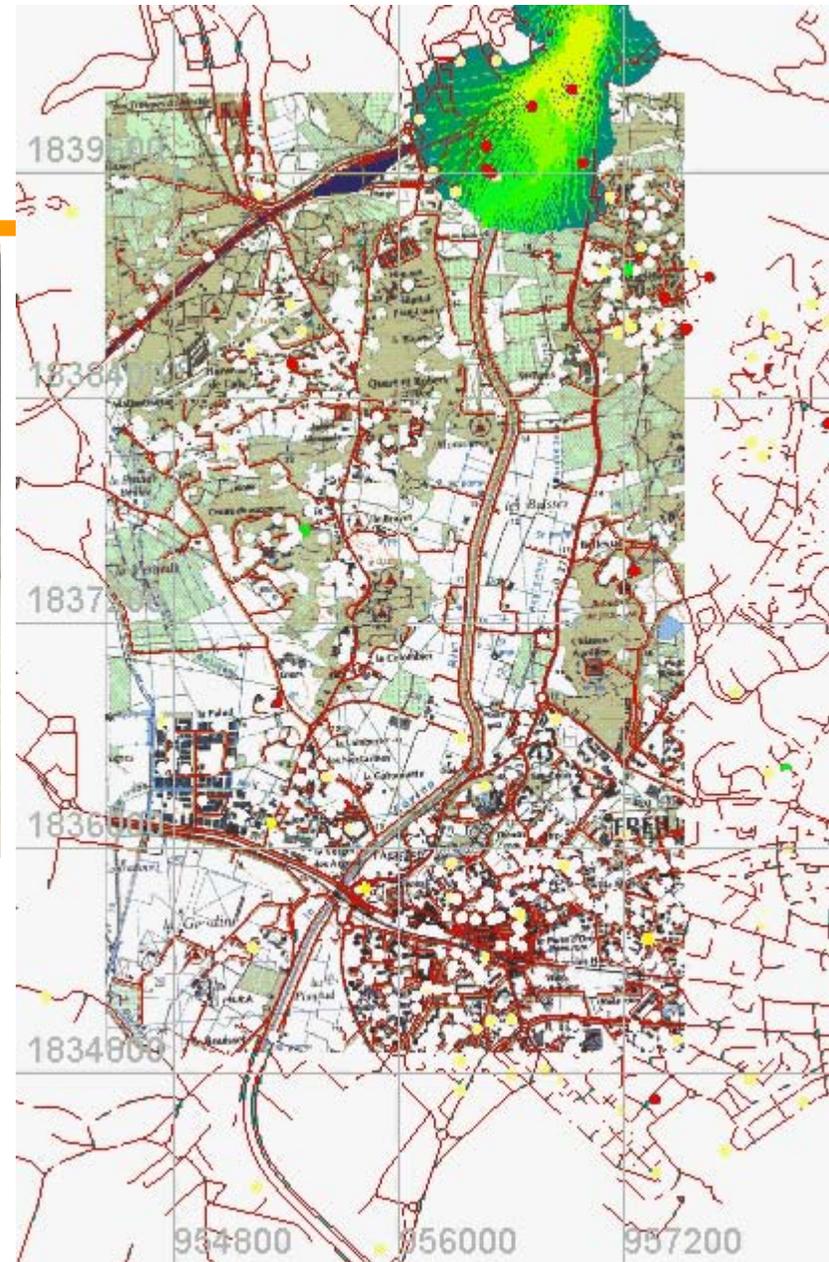
An immense human tragedy



DROWNED VICTIM of the disaster hangs head down between the ties of a rail-road track, where the twisting torrents of water finally brought his body to rest.



Valley and town



0 Days 00:20:00.000

1836800

1836000

1835200

1834400

1833600

953800

954600

955400

956200

957000

957800

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