ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

Laboratory for Safety Analysis INSTITUTE FOR ENERGY TECHNOLOGY

DMAVT Departement Maschinenbau & Verfahrenstechnik: Department of Mechanical & Process Engineering

Risk Analysis of Highly-integrated Systems

RM: Steps of Risk Management

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Risk Management, ISO/IEC Guide 73, 2002 (1)

- Definition **risk management**: coordinated activities (in different stages) to direct and control an organization with regard to risk.
- NOTE: Risk management generally includes risk assessment, risk treatment, risk acceptance and risk communication

Risk Management, ISO/IEC Guide 73, 2002 (2)

Risk Management *…coordinated activity to direct and control*				
	Risk Assessment			
		Risk Analysis		
			Source Identification… *potential for a consequence (= hazard)*	
			Risk Estimation *…events, prob., consequences*	
		Risk Evaluation *…against given risk criteria*		
	Risk Treatment *… selection and implementation of measures to modify risks*			
		Risk Avoidance *…decision not to become involved, or action to withdraw*		
		Risk Optimization *… process*		
		Risk Transfer *…burden sharing*		
		Risk Retention *…acceptance of burden/benefit … unidentified risks*		
	Risk Acceptance *…decision (by whom?)*			
	Risk Communication *…sharing info between decision maker and other stakeholders*			

RODOS (Real-time On-line Decision Support System) (1)

- It is an off-site emergency management system. It provides the methodological basis, develops models and databases and installs the hardware and software framework of a specialised DSS on emergency measures.
- Simulation models included in RODOS for **proactive actions and countermeasures** are designed to permit:
  - the estimation of the extension in both time and space;
  - the estimation of dose and health effects, with quantification of advantages and disadvantages in terms of (averted) radiation doses or (averted) health injuries;
  - the quantification of the costs for society and the economy.
- RODOS allows to evaluate alternative combinations of countermeasures and protective actions in terms of feasibility in the given situation, and to support judgements by the decision makers of the public acceptability of the actions.

RODOS (2)

Basic features

- Real-time and on-line operation coupled to existing meteorological and radiological monitoring networks.
- For aiding decisions on early emergency actions in the near field, such as sheltering, evacuation and distribution of stable iodine tablets, cycle time of 10 min. are realised.
- Two modes of operation are provided: an automatic and an interactive one.

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RODOS (3)

If connected to on-line meteorological and radiological monitoring networks, RODOS provides support for:

- Level 0: Acquisition and checking of radiological data and their presentation, directly or with minimal analysis, to decision makers, along with geographical and demographic information.
- Level 1: Diagnosis and prognosis of the current and future radiological situation based upon monitoring data, meteorological data and models, incl. source term estimation.
- Level 2: Simulation of potential countermeasures (e.g. sheltering, evacuation, iodine tablets, relocation, decontamination and food-ban) determination of their feasibility and quantification of their benefits and disadvantages.
- Level 3: Evaluation and ranking of alternative countermesures strategies by balancing their respective benefits and disadvantages.

RODOS (4)

Six principle types of consequences occur when single or multiple courses of actions are introduced:

- radiation doses to individuals and the public
- radiation induced health effects
- areas, number of people and amount of agricultural products affected by countermeasures,
- health effects caused by the countermeasures actions,
- monetary costs quantifying the economic impact of countermeasures and health effects,
- socio-psychological and political implications.

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Meteorology and Atmospheric Dispersions

- They are parts of ASY, a general diagram is presenting a sequence of models.
- For real-time applications the operational puff diffusion code is driven by wind data from a combination of:
  - a permanent network of meteorological towers
  - numerical weather forecast data.
- The data of a prognosis of a radiological situation are in form of potential dose histories on the whole computational grid.
- RODOS assist decision makers to define interventions during radiological emergencies. Phases during a nuclear emergency:
  - pre-release phase
  - release and immediate post-release phase
  - longer-term post release phase.

Simulation of Countermeasures and Quantification of Consequences

- Early emergency actions: sheltering, evacuation and administration of iodine tablets
- These actions are typically limited to areas within a circle of a few ten kilometers around and to time intervals from a few hours before the beginning of the release to several hours after the cloud of released nuclides has left the near range.
- Evacuation simulation module: it comprises the following data
  - starting time and duration of the whole evacuation
  - number of evacuated persons
  - mean transport performance in persons per hour
  - collective driving times
  - quality measure indices for the evacuation process.
  - late countermeasures: relocation and decontamination (see figures)