Landfill Safety Plan
A methodology to guarantee safe waste management

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Outline

- Landfill: a public health & environmental issue
- Modern landfill concept as a multi-barrier principle
- Framework for Safe Landfill
- Conclusions
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Landfill: a public health & environmental issue
Landfill: a public health & environmental issue

- Public health protection
  - Occupational works and scavengers
  - Disease vectors for neighbourhood exposures (birds, rodents, insects, etc.)
  - Odour, noise, litter and dust
Landfill: a public health & environmental issue

- Environmental protection
  - Leachate treatment and disposal
  - Landfill gas treatment and utilisation
  - Vegetation damage
  - Soil pollution
  - Surface water pollution
  - Groundwater pollution
  - Explosion and fire hazards
Landfill: a public health & environmental issue

What is necessary?

- More systematic information on pathogenic organisms and emergent chemicals
- Toxicology studies
- Risk assessment and risk management methodologies
- Strategies/measures for reduction of contaminants concentration levels on environment
- Contaminants removal strategies
- New concepts in legislation initiatives
Landfill: a public health & environmental issue

- Risk assessment and management paradigms

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- A fully integrated plan must consider **health** and **environmental** endpoints
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Modern landfill concept
Modern landfill concept

- The multi-barrier principle

- Operational quality management system
Modern landfill concept

- **Design concerns** *(examples)*
  - Inadequate base slope to promote leachate drainage
  - Type and thickness of geomembrane
  - Leachate collection system
  - Geologic characteristics of the landfill site
  - Groundwater protection systems
Modern landfill concept

- Construction concerns (examples)
  - Inadequate preparation of sub-base
  - Poor quality control over materials used
  - Penetration of liner containment system
  - Failure of welded geomembrane joints
  - Quality control of construction
Modern landfill concept

- Operation concerns (*examples*)
  - Poor operational procedures
  - Failure of leachate drains due to poor site practices
  - Excessive rain entry
Modern landfill concept

- Post-closure concerns *(examples)*
  - Failure of the capping system due to human or natural actions
  - Collapse of leachate collection system
  - Harmful long-term effects of inappropriate wastes
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Framework for Safe Landfill

- Health & Environmental targets

Adapted from Bartram et al., 2001
Framework for Safe Landfill

Health & Environmental based targets

Landfill Safety Plan

System Assessment
Analysis of the system (hazards, risks, events) to determine whether it can meet the targets

Operational Monitoring
Monitoring of control measures which are of particular importance in securing landfill safety

Management Plans
Documentation of system assessment and monitoring describing actions to be taken in normal operation and incident conditions, including upgrade and improvement, and communication

Independent surveillance
Verification that system operates properly
Framework for Safe Landfill

What is Landfill Safety Plan?

- LSP is a systematic approach used to ensure proper management of landfills
- LSP places emphasis on ensuring that hazards are excluded or removed at all stages of landfill systems resulting in more consistent safety guaranty for public health and environment
- LSP applies a risk assessment and management approach for landfill quality control
Framework for Safe Landfill

- Engaging everybody in a risk management culture
  - Must start from the top managers
  - Transparency with all staff
  - Encourage reporting and feedback of problems- respond positively
  - Mistakes should be seen as a way of learning
  - All staff should encouraged to “own” quality
  - Make sure all know why quality matters
  - Pride in the job and belief in the utility
Framework for Safe Landfill

Components of a Landfill Safety Plan

- System assessment
- Operational monitoring
- Management plans
- Independent surveillance
Framework for Safe Landfill

- System assessment
  
  “to determine where the landfill chain as a whole can assure a performance quality that meets identified targets. This also includes the assessment of design criteria for new systems”

- Identification of hazards and threats
- Prevention and reduction of contamination
- Concern about improvements of system performance
Framework for Safe Landfill

- Operational monitoring
  
  “monitoring of the control measures in the landfill chain which are of particular importance in securing landfill safety”

- Monitoring of control measures
- Assure that barriers are working \((\text{barriers} \equiv \text{safety})\)
- Different approaches
  - Visual Inspection
  - Quality testing
  - Standard operational procedures
Framework for Safe Landfill

- **Management plans**
  
  “management plans documenting the system assessment and monitoring; and describing actions to be taken during normal operation and incident conditions, including upgrade and improvement and documentation and communication”

- **System assessment**
- **Control measures**
- **Management procedures (routine and exceptional situations)**
- **Communication protocols**
  - Internal
  - Surveillance authorities
  - *Media e Public*
Framework for Safe Landfill

- Independent surveillance
  - Audit based
  - Direct investigation
  - Validation of control measures
Framework for Safe Landfill

- Preventative, risk-based management

**Preparation**
1. Assemble the LSP team

**System assessment**
2. Describe the landfill system
3. Identify hazards and hazardous events and assess the risks
4. Determine and validate control measures, reassess and prioritize the risks
5. Develop, implement and maintain an improvement/upgrade plan

**Operational Monitoring**
6. Define monitoring of the control measures
7. Verify the effectiveness of the LSP

**Management and Communication**
8. Prepare management procedures
9. Develop supporting programmes

**Upgrade**
- Investment required for major system modification

**Feedback**
10. Plan and carry out periodic review of the LSP
11. Revise the LSP following an incident

**Incident (emergency)**

- Preventative, risk-based management
Framework for Safe Landfill

- Stakeholders responsibilities in each step

Health & Environmental Based Targets

System assessment

Operational monitoring

Management plans

Independent surveillance

Health and Environmental Authorities

Solid waste utility

Regulators
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- Landfill safety plan. Methodology adequate for:
  - Systematic assessment
  - Minimisation of accidents probabilities
  - Contingency plans for exceptional events
  - Support for Regulators inspection activities
  - More efficient use of resources
Conclusions

- Landfill Safety Plans challenges:
  - Landfill Quality Management is everyone's business
  - Changing staff attitude & work culture
  - Willingness of Management to spend on improvements
  - Commitment of landfill technical staff to stick to schedules set
  - How to involve consumers in LQM & raise their concern
Conclusions

Stakeholder Involvement

Solid Waste Utility

Health Authorities

Consumers

Environmental Authorities

Economic Activities

Regulators

Stakeholders involved are:
- Health Authorities
- Environmental Authorities
- Consumers
- Economic Activities
- Regulators