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CONTENTS

FIGURES

1. INTRODUCTION

Environmental analysis refers to the design analysis which is required to determine detailed environmental conditions applicable to a specific system. It is executed for determination and documentation of the environmental profile for a system, plant or facility, including the system users and operators, during its life-cycle.

It includes all operating and non-operating environments (including storage and transport), as well as expected operating and non-operating states (including maintenance) and environmental factors, both natural and man-made, e.g. temperature, vibration, shock, solar radiation, etc.

The definition of “environmental analysis” used in this guideline is intended to include only physical aspects of the environment and to exclude the meanings of the word “environmental” that refer to other human activities and endeavours, such as, cultural, social, political and economic environments.

An Environmental Impact Analysis (EIA) is also excluded here and is assumed to have been completed or exempted

2. SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

This document provides a guideline for conducting an environmental analysis during the requirements analysis phase of a project, prior to the conceptual design. The principles, processes and typical parameters of conditions to be considered are presented.

2.1.2 Applicability

This guideline applies to all Eskom projects that involve systems, plant, facilities and material assets.

Please Note: This guideline is not meant to be used or applied in its entirety but, rather, to be customised for projects and systems; for certain projects, a small part of it may be relevant and applicable - see Appendix A.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] ISO 9001 Quality Management Systems

2.2.2 Informative

The following documents as listed, although not invoked in this specification, provide additional information or examples.

[2] IEC 60068, "Environmental Testing".

[3] IEC 60945, "Maritime navigation and radio communication equipment and systems - General requirements - Methods of testing and required test results", issued 2002 and due for review in 2007

[4] MIL-STD 810, US Department of Defence.

[5] IEC 60529 “Degrees of Protection Provided by Enclosures (IP Code)”

2.3 DEFINITIONS

Environmental Analysis - Physical aspects of the environment not including human activities and endeavours, such as, cultural, social, political and economic environments.

Meteorological data- Meteorological facts pertaining to the atmosphere, such as wind, temperature, air density, and other phenomena that affect operations.

2.3.1 Classification of Environment

2.3.1.1 High-level classification

The system, planned plant or facility of interest will be exposed to the natural environment which is prevailing at the proposed selected site, both during construction and the operational life time of the system/plant/facility.

Also, inside the facility, different environments may exist after completion of construction. These environmental conditions may be detrimental to humans, equipment and components. Some components or sub-systems may be required to function in very harsh conditions, while more sensitive equipment and personnel require less harsh conditions.

At the highest level the environment, therefore, can be classified as:

- External Site conditions, relating to the prevailing natural and man-made conditions; and
- Internal to the system/plant/facility, where functional requirements change the natural conditions.

2.3.1.2 Second level classification

2.3.1.2.1 Site Conditions

At the next level, the environmental analysis should address aspects that will appear in the Site Envelope Parameters specification - see template in Appendix C

The analysis may also classify the natural environment in a manner that will enable the rest of the requirement analysis and specification generation teams to consider widely known aspects usually associated with such areas, such as, the climate or land use categories.

Local climatic regions include coastal, high-veld, low-veld, savannah, grassland, coastal, semi-desert, desert, Mediterranean, sub-tropical, etc. Land use gives an indication of infrastructure that is usually available, such as, agricultural, industrial, rural tribal land, etc.

2.3.1.2.2 Internal Conditions

For certain requirements, the analysis must take into consideration what the conditions in internal environments will be. This will require areas to be classified according to a suitable system of categories, e.g. as “safe for personnel” or “suitable only for certain classes of equipment and components” etc.

The categories of internal environmental conditions will be influenced by the degree of control over these conditions that can be implemented. In some areas of a facility, it may be necessary to make it inhabitable by adding HVAC elements or sound dampening measures; in other areas it may be necessary or more cost-effective to utilise sub-systems and components specially designed for harsh environments.

Several design standards, categorising the capability of equipment to withstand environmental conditions, are available, e.g. ingress of liquids and solids (mostly dust) is classified by industry standards making use of IP codes (IEC 60529), similar to the NEMA ratings.

Many aspects of internal conditions of a system/plant facility are controlled by national laws, regulations and prescribed procedures, while local authorities may impose further regulatory measures. Conformance to the well-known OHS Act is regularly monitored by the relevant authorities.

A good example of environmental analysis processes and specifications, as well as categorised controlled areas or environments, is found in and around nuclear power plants due to the inherent risks associated with such power plants and the requirements to control nuclear fission - see Appendices.

Power stations using coal as a primary energy source also includes similar areas where the environmental conditions should be categorised and specified. Steam noise or whistling at the power station is often a problem. Changed hood design, instead of ear protection, could be used to address the problem.

2.4 ABBREVIATIONS

Abbreviation	Description
EIA	Environmental Impact Analysis
EMI	Electromagnetic Interference
FMEA	Fault Mode and Effect Analysis
HVAC	Heating, Ventilation and Air Conditioning
IEC	International Electrotechnical Commission
INL	Idaho National Laboratory, a US Department of Energy Laboratory
IP	Ingress Protection
NEMA	NEMA (The US National Electrical Manufacturers Association)
OHS	Occupational Health and Safety.
SHE	Safety, Health and Environment
TBD	To Be Defined

2.5 ROLES AND RESPONSIBILITIES

Not Applicable.

2.6 PROCESS FOR MONITORING

Not Applicable.

2.7 RELATED/SUPPORTING DOCUMENTS

Not Applicable.

3. ENVIRONMENTAL ANALYSIS

3.1 PURPOSE AND OBJECTIVES OF ENVIRONMENTAL ANALYSIS

The main objectives of the analysis are to accurately determine and describe the environmental profile that the proposed system will be subjected to during all phases of the life-cycle of the system of interest.

The environmental analysis should also produce results that can provide essential inputs to the risk management functions and procedures associated with both the design and construction phases of a project and the operational life of the constructed facilities.

For the purposes of this analysis guide, the environment is defined as the natural and man-made prevailing conditions. Natural conditions include atmospheric, weather or earth-related conditions at the boundaries of the system and its interfaces to the natural environment. The natural environment at the system's boundaries may be influenced by human actions and man-made installations and structures. Included in the physical environment are all materials present, e.g. chemicals and chemical compounds in the solid, liquid and gas phases and at the transitions between the phases. Other parameters, for example those related to electromagnetic units or quantities, energy-related parameters like temperature, potential differences and effects of gravity, are included.

This environmental analysis refers to the influence of the environment on the system, plant, installation or facility and does not address the influence of the system on the environment which should be analysed before the project is approved by means of an Environmental Impact Analysis (EIA). Where requirements for system specifications are derived from the environmental analysis, the applicable results of the EIA should be considered. Verification of system performance should be conducted against the results of the Environmental analysis of interest.

The environmental analysis for a new system, facility or installation should be done at the earliest phase in the life-cycle of the system. Environmental requirements are an important component of the system/sub-system/component requirements set and the environmental analysis forms part of the requirements development of systems.

During the conceptual design, environmental analysis should provide significant input to early design stages, i.e. the "design-for" stages, as the purpose is to analyse the environment which the system must operate in.

The environmental analysis should continue through the later design phases to assure the capability of the system to operate in the anticipated environment, where some aspects of the environmental parameters become clear only later during the design process. This is also often due to design decisions that may introduce an increase in the sensitivity of the system design to the anticipated environmental conditions.

Finally, the system design reviews and development tests as well as verification and validation tests will be done to prove conformance to environmental specifications, which will be derived from the results of the analysis.

3.2 ENVIRONMENTAL ANALYSIS PROCESS

The analysis process should include all the tasks and activities required to identify and quantify all environmental parameters that could have an influence on the envisaged system. The influence of the environment on all aspects that could affect the system performance throughout the system life-cycle, up to decommissioning, must be considered, especially RAM.

The applicable parameters, as identified by the analysis, should be quantified, i.e. expected and extreme values must be determined. Expected storage, transport and operating conditions should be determined with the relevant tolerances.

3.2.1 Environmental Analysis process steps

The environmental analysis process should be defined as a series of logical steps to obtain sufficient data that can be analysed and interpreted. This should be done to a level of detail that will enable system designers to make the required design decisions, from the analysis, about the environmental specifications, as part of the systems specification.

The process steps can be defined as:

3.2.1.1 Compile System Environmental Profile

- Examination of international and national standards and norms;
- Inspections at the location for planned plant, equipment, installations, facilities and systems;
- Examination of meteorological data and records, where available, at the planned location; and
- Surveys and measurements of environmental parameters at the planned location.

3.2.1.2 Allocate Environmental Classification

- Examination of national and local authorities' by-laws and regulations relating to SHE;
- Inspections at the sites of existing similar systems;
- Interviews with operators of existing similar systems; and
- Definition and listing of areas and spaces that can be classified thus far (as described in section 2.3.4).

- Allocation of classification to areas and spaces that can be classified thus far.

3.2.1.3 Develop Environmental Specifications

- Compilation of environmental analysis report as an input to system specifications;
- Examination of client requirements and specifications;
- Examination of operational requirement for the planned plant, equipment, installations, facilities and systems;
- Review of similar systems' specifications; and
- Compilation of environmental specifications that will form part of the system specification.

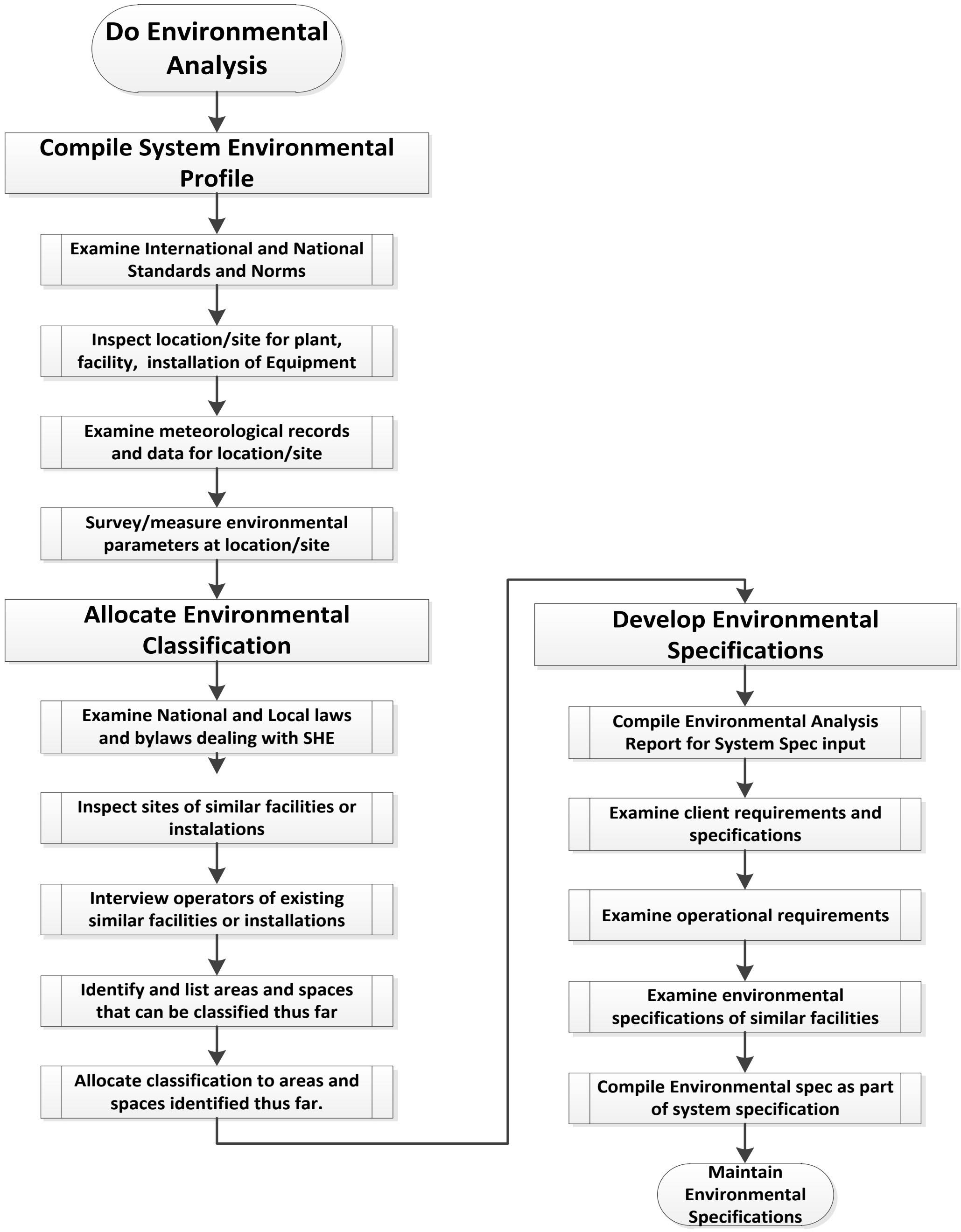

Figure 1: Environmental Analysis Process Flowchart

3.3 ENVIRONMENTAL PARAMETERS

Please Note: Due to the fact that much of Eskom's plant, equipment, installations, facilities and systems have a very long design life, some environmental parameters are mentioned to encourage consideration of possible future scenarios and may appear obscure or vague.

This guideline is intended to be tailored as applicable, while attempting to provide potentially useful information that may seem irrelevant.

While some systems will be subjected to unique environmental parameters, the following list of parameters can be used as a checklist or guideline of parameter values to be determined. Most parameters are self-evident; it is the objective of the environmental analysis to determine preliminary numerical values that will be required for the design phases. Some notes to emphasise certain exceptional issues are provided:

3.3.1 Parameters relating to system functional aspects

These parameters become relevant due to the fact that the system is designed to perform certain functions and, similarly for all environmental parameters, the limits within which the system will be able to operate must be specified.

3.3.1.1 Vibration

The effect of vibration on sensitive parts and sub-systems during operation, and transportation should be included. Milling plant vibration at a power station is a relevant example.

3.3.1.2 Shock

Damage due to shock is an important consideration for parts and sub-systems that will be handled or moved, especially for spares and stock that will be handled in stores.

3.3.1.3 Acceleration

Design procedures of parts and sub-systems usually include verification of the ability to withstand acceleration during normal operation. The acceleration that materials will be subjected to also forms part of the process design; here the analysis should endeavour to identify situations specific to the system of interest. The acceleration of fans at a power station, rather than the fan speed, is an example of this factor that should be addressed.

3.3.1.4 Temperature Shock (fast rising or falling temperature)

Materials, parts and sub-systems may not be able to function with or withstand rapid changes in temperature, especially internal to the system and at interfaces with other systems. This aspect should be considered for plant/process start-up and shut-down conditions. Another example is the temperature shock that a high pressure by pass valve at power stations may be subjected to.

3.3.1.5 Immersion

Often parts and sub-systems are unaffected by unintentional submersion, while others only require cleaning and/or drying. However, a large proportion of the parts of systems are totally incompatible with immersion in any liquid.

Specifications concerning the ability of parts or sub-systems being immersed in water or other liquids should be very clear about the depth of immersion and liquid temperature due to the associated pressure changes. This parameter plays an important part in the design and/or mounting of sub-systems; several instances of unintended immersion should be considered, including the risks of minor flooding due to liquid leaks or other unexpected sources. The design team members involved with the system FMEA process, risk analysis and environmental analysis should collaborate with respect to this aspect.

3.3.1.6 Corona Discharge

This phenomenon, relating to high voltages, is widely understood in Eskom. However, it should still be included in the analysis to highlight exceptional circumstances, if relevant.

3.3.2 Parameters relating to materials present in the environment

This section lists parameters that may affect system performance under certain circumstances - it is intended to invoke the analysis to evaluate the possibility of circumstances occurring. The specific examples mentioned are only an indication of the obscure nature of events to be considered.

3.3.2.1 Solids

If in the vicinity of sharply sloping land, consider the possibility of rolling rocks or landslides.

3.3.2.2 Liquids

Flooding is the obvious example but the presence of unintentionally spilled liquids within the facility, e.g. in indoor spaces with close to open containers, should also be considered as part of the environment.

Where there is no option but to place facilities close to waterways, consider the 10 year, 20 year and up to 50 year flood lines.

3.3.2.3 Gases

The composition of the atmosphere around a system, both outside and inside a facility, may be detrimental to the operation or lifespan of the system. The obvious example is the gases emitted by chemical industries. Other less obvious circumstances may include disrupting smoke from veld-fires or causes thereof.

3.3.2.4 Transitions between the phases

The weight and the melting of accumulated hail on flat roofing is an example as well as the effects of freezing water which should not, under normal circumstances, be present.

3.3.2.5 Chemical reactions and pollution

The effects of acid rain and polluted water are well-documented. Acid mine water may be a future problem in certain areas.

3.3.3 Parameters relating to energy interactions in the environment

3.3.3.1 Lightning

Lightning protection for transmission is self-explanatory. For control systems, the problem can be alleviated by using, for example, fibre optics for signal lines.

3.3.3.2 Solar Radiation

Due to the long design life for Eskom systems, many materials will not be suitable due to their susceptibility to degradation by solar radiation, notably, plastics. The intensity of solar radiation (heat as well as UV) and the hours per day associated with these levels must be considered.

3.3.3.3 Nuclear Radiation

This is a highly critical environmental aspect that is beyond the scope of this guide.

3.3.3.4 Electromagnetic fields

Apart from electromagnetic fields caused from the use of heavy industrial machinery, many other sources of Electromagnetic Interference (EMI) can cause the malfunction of parts and sub-systems, especially electronic communications. EMI susceptibility often occurs due to the interference between parts and sub-systems of the system of interest, due to oversights during the design phase.

3.3.3.5 Electrostatic discharge

Electronic components are sensitive to electrostatic discharges and when the air humidity is low, i.e. on very dry days. Static electricity often builds up and care must be taken, especially in control rooms where the wrong flooring material can create havoc.

3.3.4 Parameters relating to atmospheric & weather conditions

Even though weather conditions only affect open installations, some parameters like humidity can affect sub-systems within buildings.

3.3.4.1 Rain intensity

Rain intensity, measured in millimetres per hour, should be specified. Military standards and specifications can provide useful information.

3.3.4.2 Flooding

Self-explanatory, also see Immersion in 3.3.1.5.

3.3.4.3 Snow and Hail

Heavy snow is not a frequent condition in the areas serviced by ESKOM. Specifications typically specify thickness of snowfall for outdoor installations.

Due to climate change, hail should be considered in the environmental assessment.

3.3.4.4 Atmospheric pressure (high and low)

For most systems, this is related to the altitude of the area serviced by Eskom, mostly, from sea level to approximately 2000 meters above sea level.

Local variations of atmospheric pressure can affect indoor conditions unless an area is adequately sealed and the pressure is controlled, e.g. by air-conditioning that maintains a small over-pressure.

3.3.4.5 Wind Speed and Direction

The forces applied to structures by wind are directly proportional to the wind speed.
Wind direction can affect the cooling, and hence output of dry cooled power stations.

3.3.4.6 Dust

As Eskom operates in dry to very dry areas, this is an important parameter to specify. Several industrial specifications classify the amount of protection that equipment enclosures provide against the ingress of dust, e.g. IP65, etc. (See IEC 60529)

3.3.4.7 Humidity: High & Low

Humidity variations are highly dependent on prevailing weather conditions and it also affects indoor systems, unless it is controlled by air-conditioning systems.

3.3.4.8 Salt spray and fog

This very common weather condition near the coast-line imposes very rigid specifications on all outdoor equipment installations and structures. The corrosion caused by salt spray and fog has a very negative effect on expensive capital assets such as plant, installations and facilities.

3.3.4.9 Blown Sand

Blown sand can damage the surfaces of equipment, plants and facilities and the severity is directly related to the wind speed and sand/soil composition.

3.3.5 Parameters relating to biological environmental conditions

3.3.5.1 Fauna

The area served by Eskom is home to a wide variety of wild animals and birds as well as farm animals that can influence installations, such as, the installation of pylons. Rodents in powers stations or at sub-stations are an example of this problem that often occurs.

3.3.5.2 Flora

Installations require maintenance against overgrowing grass, trees interfering with transmission lines and several other related issues. The environmental analysis, therefore, should include this aspect.

3.3.5.3 Fungus

The possibility of fungus growth and its effects on equipment should be included in the analysis.

3.3.6 Parameters relating to the geographical and geological environmental conditions

3.3.6.1 Slope (operating at an angle)

Analysis should address issues like rock falls, landslides and the affects of steep slopes on transportation, maintenance, etc.

3.3.6.2 Seismic events

The seismic background information should be considered for large plants and installations, in collaboration with the risk management function.

3.3.6.3 Altitude

The altitude at which a system operates determines the atmospheric pressure, as discussed in section 3.3.4.4.

Additional considerations for the analysis are the fact that the atmosphere contains less oxygen at higher altitudes and temperatures are generally lower at higher altitudes.

3.3.7 Parameters relating to human actions and man-made installations

Some aspects have already been discussed, such as industrial pollution. Several other issues, however, may be identified during the survey of sites.

3.3.8 Geographic Location (Longitude and Latitude)

The analysis should take note of the geographical location of the planned system, e.g. country-specific and hemisphere-specific environmental conditions, when a system is designed for installation in another country. Issues, such as in which direction a sawtooth factory should face in the northern hemisphere etc, should be brought to the attention of the design team.

3.3.9 Other parameters

This listing of parameters is not complete - depending on the system of interest, other conditions may be relevant. The Appendices contain requirement specifications, where other parameters, specific to the industry involved, are addressed.

3.4 DOCUMENTATION OF THE ENVIRONMENTAL ANALYSIS

Documentation from the environmental analysis should be made available later for several possible uses during the operational life of the system and, in extreme cases, even as an input to the investigation of an accident. Therefore, all data collected and other documentation should be placed under configuration control.

An issue, which is more important to other design and construction activities than for environmental analysis, is long-term availability of the electronic documentation media. Due to the long-life expectancy of Eskom systems (often longer than fifty years with rebuilds etc.), it is very important that documentation on electronic media will still be usable after a long period of time. Many years after the beginning of the widespread use of the personal computer, some industries are now experiencing problems accessing documentation stored on obsolete media, by obsolete operating systems that are unable to operate on current technology. Where precautions were taken to preserve all the required equipment and software, problems are encountered due to deteriorated/corrupt floppy disks or hard drives.

Reports and results must be circulated as widely as possible to ensure that all parties concerned are fully aware of the conditions for which they must design.

Documentation associated with environmental analysis should, if applicable, include the following:

- Data gathered, e.g. site measurements, meteorological records consulted, etc
- Analysis documents
- Documentation prepared for reviews
- Minutes, action lists and reports resulting from reviews
- The final environmental analysis results, reports, and inputs into the system specifications, which should be augmented by a brief summary of the approach taken during the analysis, and relevant historical facts.

3.5 LIMITATIONS OF ENVIRONMENTAL ANALYSIS

3.5.1 Limitations

In certain scenarios, an environmental analysis may provide results that are not completely sufficient to reduce environmentally-related risks.

A few examples are:

- When any relevant aspect of the environment unexpectedly changes during the design life of the system. Should the possibility of an environmental change exist at the outset, the analysis should identify it in order for the design team and risk management function to take it into consideration;
- When new (immature) technology is utilised, for which little field data is available; and
- When a system is utilised in an environment that is very different from that usually encountered, some aspects of deployment may easily be overlooked. (An example could be when a system, dependent on GPS satellite coverage, is deployed in the southern hemisphere for the first time, while calculations embedded in the software were previously only required to handle locations in the northern hemisphere.)

3.5.2 Barriers to the implementation of Environmental Analysis

The following barriers are often the result of project management-related issues:

- A limited budget;
- Time-to-completion constraints; and
- Perceptions and attitudes, often expressed with phrases, such as “we know what we are doing”, “we have done it many times before” and “it’s a waste of time, what value can it have?”

4. AUTHORISATION

This document has been seen and accepted by:

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5. REVISIONS

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6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

Reliability and Safety Engineering during Design Work Group Acknowledgements

APPENDIX AE PININSKI, ESKOM WAS THE ORIGINAL DEVELOPER OF THIS DOCUMENT. : EXAMPLE OF A TEMPLATE FOR SITE CONDITIONS

(Extracted from INL documents, with imperial units.)

Table 3.5-1: Summary Characteristics of the INL Site

Parameter	Value
Soils:	
Depth	0 to 4 ft of alluvium overlying basalt
Static bearing capacity, psf	[TBD]
Soil shear modulus, psf	[TBD]
Water:	
Source	Plain aquifer
Depth	475 ft
Quality	[TBD] – see Section 9, Table 9-1
Availability	>30,050 ac-ft/yr
Climatology:	
Avg. air temp (°F)	Annual avg: 42.6; Extreme high: 101; Extreme low: -47
Precipitation, in	Annual high: 14.4; Annual low: 4.5; Annual avg: 9.07
Wind Speeds, mph	
At 20 ft elev.	Annual avg: 7.5; Annual highest: 51
At 250 ft elev.	Annual avg: 51; Annual highest: 67
Tornado [(1)]	
Annual risk probability	7.8×10^{-5}
Maximum wind speed, mph	175
Tangential velocity, mph	145
Translational, mph	30
External pressure drop	0.65 in at 0.25 psi/sec
Other	
Flooding	No special provisions are required
Seismic [(2) (3)]	
Site location	Use INL “Power Burst Facility” as surrogate location
Performance category (PC)	PC 1 to 4, DOE-STD-1020-2002,
PC 1 and PC 2 SSCs	International Building Code (IBC) 2000
PC 3 and PC 4 SSCs	ICP Architectural Engineering Standards Design Basis Earthquake Parameters (Appendix S)
Volcanic activity	Risk of ash fall must be considered on a site specific basis

APPENDIX B: EXAMPLE OF SPECIAL EXTERNAL EVENTS

(Compiled from different sources)

- Deliberate Aircraft Impact

NRC specifies an impact profile for a large, fully-loaded commercial aircraft:

- The NHSS design shall accommodate the reference aircraft impact, defined below, within the provisions of Top Level Regulatory Criteria (TLRC) Related to Beyond Design Basis Event (BDBE).

Weight of impacting body:	[20,000 kg (44,000 lb)]
Speed of impacting body:	[215 m/s (705 ft/s)]
Impact angle coefficient (speed coefficient):	[0.7]
Equivalent diameter of the impact for penetration evaluations:	[2.6 m (8.5 ft)]
Impact surface:	[7 m^2 (75 ft2)]

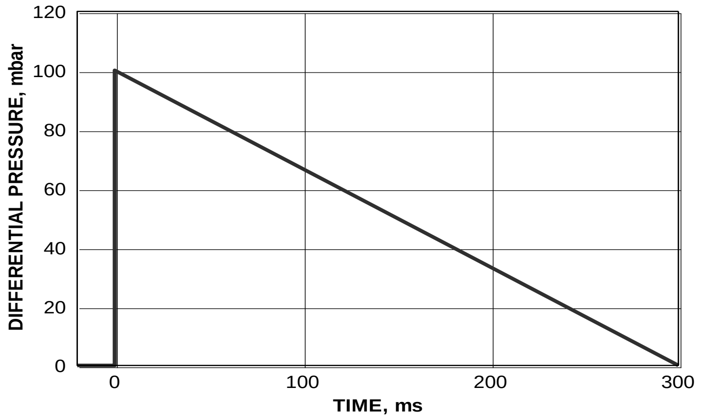
"The assessment must be based on the beyond-design-basis impact of a large, commercial aircraft used for long distance flights in the United States, with aviation fuel-loading typically used in such flights, and an impact speed and angle of impact considering the ability of both experienced and inexperienced pilots to control large, commercial aircraft at the low altitude representative of a nuclear power plant's low profile."

Example:

External structures classified as safety-related, shall be designed and constructed with consideration of aircraft impacts, as required by NRC final rule RIN 3150-AI19.

- External Detonation Shock Wave

The standard Nuclear Island shall accommodate the reference external detonation shock pressure wave, defined in the figure below, within the provisions related to Beyond Design Basis Events.



Reference Shock Pressure Wave

- Airborne Industrial Threats

The plant shall be designed to ensure habitability of the standard Nuclear Island control rooms in the presence of airborne industrial threats.

Provision shall be made for short term protection for onsite staff from airborne industrial threats.

All equipment shall be protected from or designed to withstand corrosive environments for the life of the plant.

APPENDIX C: EXAMPLE OF SITE ENVELOPE PARAMETERS

(Example for nuclear reactor sites)

MAXIMUM GROUND WATER LEVEL	0.6 m (2 ft) below grade
MAXIMUM FLOOD (OR TSUNAMI) LEVEL	0.3 m (1 ft) below plant grade[1]
PRECIPITATION (for Roof Design)	
• Maximum rainfall rate	493 mm/hr (19.4 in/hr)[2] 157 mm (6.2 in)/5 min.
• Maximum snow load	244 kg/m^2 (50 lb/ft^2)
AMBIENT AIR TEMPERATURES[(3)]	
• <u>5% Exceedance Values</u>	
Maximum dry bulb	35°C (95°F)
Maximum wet bulb	25°C (77°F) coincident 26°C (79°F) non-coincident
Minimum	-21°C (-5°F)
• <u>1% Exceedance Values</u>	
Maximum dry bulb	38°C (100°F)
Maximum wet bulb	25°C (77°F) coincident 27°C (80°F) non-coincident
Minimum	-21°C (-10°F)
• <u>0% Exceedance Values</u>	
Maximum dry bulb	46°C (115°F)
Maximum wet bulb	27°C (80°F) coincident 27°C (81°F) non-coincident
Minimum	-40°C (-40°F)
• <u>Values for Economic Assessments</u>	
Mean	16°C (60°F dry bulb) 11°C (52°F wet bulb)
SITE ELEVATION	
• Range for Design	0 –1830 m (0 – 6000 ft) above mean sea level
• Mean for Economic Evaluations	30 m (100 ft) above mean sea level
EXTREME WIND	
• Basic wind speed	177 km/hr (110 mph)[(4)]
• Importance factors	1.0[(5)]/1.11[(6)]
TORNADO [(7)]	
• Maximum Tornado Wind Speed	483 km/hr (300 mph)
• Maximum Rotational Speed	386 km/hr (240 mph)
• Maximum Translational Speed	97 km/hr (60 mph)
• Radius of Maximum Rotational Speed	46 m (150 ft)
• Maximum Pressure Drop	14 kPa (2.0 psi)

[1] Probable maximum flood (PMF) level, as defined in American National Standards/ (ANSI/ANS 2.8-1983, Determining Design Basis Flooding at Power Reactor Sites. Minimum value to be basis of standard plant design with provisions for accommodation of flood levels up to maximum value.

[2] Probable maximum precipitation (PMP) for a one hour interval for 1 square mile. The PMP for a five minute interval applies a factor of 0.32 in accordance with the National Weather Service Publication HMR No. 52.

• Rate of Pressure Drop	8.3 kPa/s (1.2 psi/s)
• Missile Spectra	Spectrum A of SRP 3.5.1.4
SOIL PROPERTIES(8)	
• Minimum Bearing Capacity (static)	≥ 73,000 kg/m^2 (15,000 lb/ft^2)
• Minimum Shear Wave Velocity	≥ 305 m/s (1000 ft/s)
• Liquefaction Potential	None (at site-specific SSE)
SEISMOLOGY(9)	
• Reference SSE PGA(10)	[0.3 g(11)(12)]
• SSE Design Response Spectra	[Reg Guide 1.60 (13)]
• SSE Time History	[Envelope SSE Response Spectra]
• Seismic Margin Evaluation Level	[0.5 g]
• Plant Shutdown Evaluation Level	[0.1 g]
SITE BOUNDARIES	
• Exclusion Area Boundary	425 m (0.26 mi) from reactor release
• Low Population Zone	425 m (0.26 mi) (same as EAB)
• Inhalation Emergency Planning Zone	425 m (0.26 mi) (same as EAB)
• Ingestion Emergency Planning Zone	[TBD] (14)

(3) The 5%, 1% and 0% ambient air temperature exceedance values are intended for use in the design of structures, systems and components that serve safety and investment protection functions.

(4) 50-year recurrence interval. At and above a height of 10 m (33 ft) above grade per ASCE 7-88, July 1990, Category III.

(5) Importance factor to be used for non-safety-related structures per ASCE 7-88, July 1990.

(6) Importance factor to be used for safety-related structures per ASCE 7-88, July 1990.

(7) 1,000,000-year tornado recurrence interval with associated parameters based on ANSI/ANS 2.3, 1983.

(8) Values of bearing capacity and shear wave velocity are included in this table to assure the plant can be located on a wide variety of soil types.

(9) The seismic methodology and parameters cited here are “legacy” provisions circa 1995 to provide interim guidance pending completion of the broader effort within the nuclear industry to more fully utilize probabilistic methods. The seismic accelerations cited pertain to the design of safety-related structures, systems, and components (SSCs).

(10) SSE PGA = Safe Shutdown Earthquake Peak Ground Acceleration

(11) Free-field at plant grade elevation.

(12) Envelopes all present U.S. nuclear sites except those on the California coastline.

(13) NRC Regulatory Guide 1.60

(14) Appropriate requirements for limiting the disturbance of offsite crops, livestock, etc., will be established. An effort is required to develop criteria and screen the options (e.g., size of the ingestion pathway EPZ, design modifications, etc.)