HIGH LEVEL SAFETY, HEALTH AND ENVIRONMENT RISK ASSESSMENT
- SPECIALIST SCOPING REPORT INPUTS:

Scoping and Environmental Impact Assessment (EIA) Process for the Proposed Development of a Solar Energy Facilitity and Battery Energy Storage Facility (Sunveld Energy PV) and associated infrastructure, east of Velddrif in the Western Cape

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Version 1: 5th September 2023

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List of Abbreviations

BA	Basic Assessment
BESS	Battery Energy Storage System
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
EMPR	Environmental Management Program
GPS	Geographic Positioning System
MWac	Mega Watt (alternating current)
PV	Photovoltaic
RA	Risk Assessment
SHE	Safety Health and Environment
S&EIA	Scoping and Environmental Impact Assessment

HIGH LEVEL SAFETY AND HEALTH RISK ASSESSMENT

This report serves as the Scoping Phase High-Level Safety and Health Risk Assessment for the Battery Energy Storage Facility that was prepared as part of the Scoping and Environmental Impact Assessment (S&EIA) for the proposed development of an 600MW Solar PV Energy Facility (Sunveld Energy PV) and associated infrastructure, east of Velddrif, in the Bergrivier Local Municipality, in the West Coast District Municipality within the Western Cape Province.

Figure 1: Map showing the location of the proposed Sunveld Energy Solar PV Facilities

1. Introduction

1.1. Scope, Purpose and Objectives of this Specialist Input to the Scoping Report

To provide a scoping report for the full high-level safety and health risk assessment that will be conducted as part of the EIA for the battery energy storage systems (BESS) proposed as part of the Sunveld Energy Solar PV Facilities.

1.2. Details of Specialist

This specialist assessment has been undertaken by Debra Mitchell of ISHECON cc. Debra Mitchell is a registered Professional Engineer with the Engineering Council of Southern Africa (ECSA), with Registration Number 72291 in the field of Chemical Engineering. A curriculum vitae is included in Appendix A of this specialist input report.

In addition, a signed specialist statement of independence is included in Appendix B of this specialist input report.

1.3. Terms of Reference

The Terms of Reference for the desktop assessment that will be completed during the EIA Phase of the project include:

- A description of the region and local features;
- A study of the battery technologies to be used;
- Identification of sensitive receptors in the area;
- Assessing (identifying and rating) the potential impacts on the health and safety of employees, contractors and public persons;
- Identification of relevant legislation and legal requirements; and
- Providing comments on recommendations on possible preventative and mitigation measures included in the Environmental Management Programme (EMPr).

The BESS Risk Assessment will serve as a technical report, and Appendix 6 (Specialist Study Requirements) of the EIA Regulations will thus not be applicable.

2. Approach and Methodology

The following approach will be used:

The Project Developer will provide technical information, EIA information for the facility and the proposed BESS, and GPS coordinates to locate the site on Google maps etc.

The Health and Safety specialist will then complete the following:

- Gather all relevant Safety Health and Environmental (SHE) information e.g.
  - ~ locations, surroundings, topography, types of activities surrounding the sites, vulnerable receptors (this will be based on Google Earth and information provided from other specialist reports);
  - ~ material listings (details of the types of batteries – only solid state, redox flow and molten metal will be considered), inventories (battery sizes and numbers), design drawings (possible layouts), process conditions (the client will be expected to provide this design information);
  - ~ maps, weather data; and
  - ~ key operating instructions and emergency procedures (if available from the client).
- Using the checklist in section 2.1 below and a guideline, identify potential SHE hazardous events associated with the installation, during construction, operation and eventual decommissioning phases.
- Using a suitable risk assessment matrix (see section 2.1 below) dimension each of the hazardous events in terms of potential consequences and likelihood.
- From this determine the raw risk and determine which items may need further attention.
- Suggest risk reduction measures (mitigation) that should typically be applied, e.g. National Standards, best practices, and monitoring requirements. Preventative measures will be to reduce the likelihood and mitigative measures to reduce the consequences. These measures will be incorporated into the EMPr.

- Calculate, and document, the residual risks.
- Determine if any of the risks require further non-standard risk reduction measures, e.g. suggested separation distances from vulnerable receptors.
- For the proposed installations compile all the information, analysis, assessments and conclusions as detailed above into a technical risk assessment report.
- Provide electronic responses and report updates for relevant issues raised.

2.1. Information Sources

Study of the area to determine sensitive receptors will be based on satellite images available on Google earth. The satellite image below show the area of study (i.e. the full extent of the affected farm properties outlined in white).

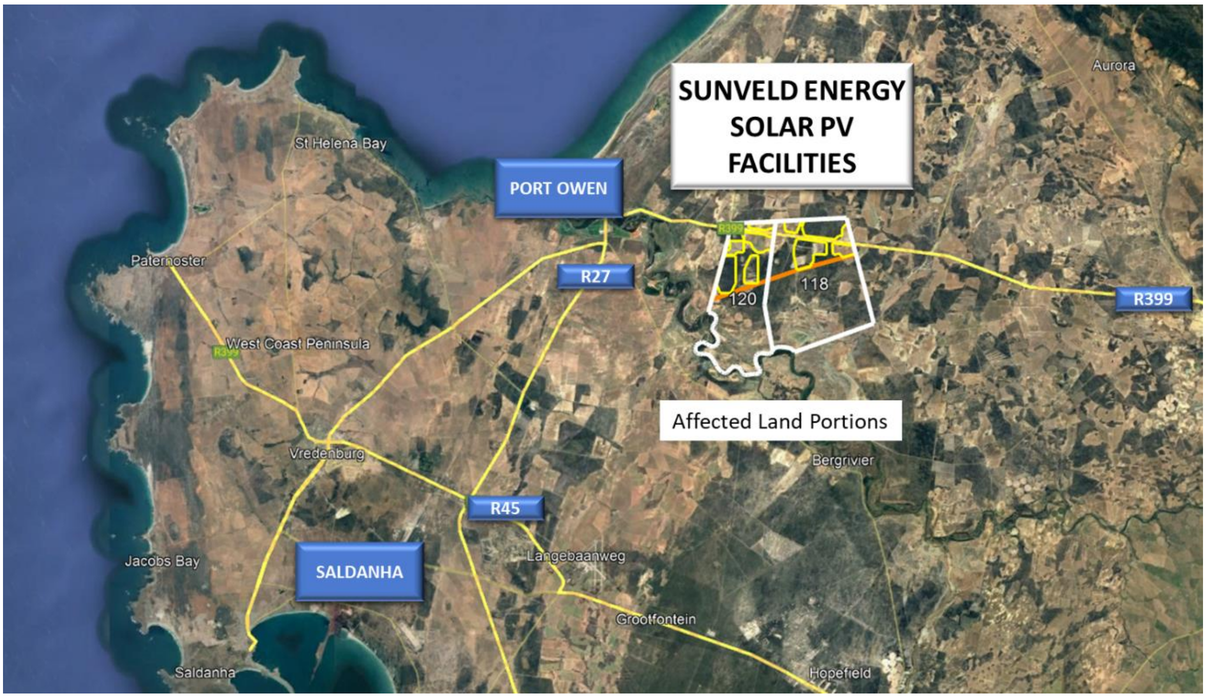

Figure 2: Satellite Image of the general area showing the affected farm portions (white shape).

The following list of generic SHE issues will be considered for each phase of the project:

TABLE 1 – SHE Checklist

NO	RISKS
	HEALTH RISKS
H1	Chronic Chemical or Biological Toxic Exposure
H2	Noise
H3	Environmental
H4	Psychological
H5	Ergonomics
	SAFETY RISKS
S1	Fire
S2	Explosion
S3	Acute Chemical or Biological Toxic Exposure
S4	Acute physical Impact or violent release of energy
S5	Generation impact
	ENVIRONMENTAL RISKS
E1	Emissions
E2	Pollution
E3	Waste of resources
	GENERAL RISKS
G1	Aesthetics
G2	Financial
G3	Security
G4	Emergencies
G5	Legal compliance

The following Risk Matrix will be used:

TABLE 2 – RISK MATRIX

Factor	**Score**	**Description**
a) The magnitude of impact on safety health and environment, quantified on a scale from 0-5, where a score is assigned.	0	small and will have no effect on the environment
	1	minor and will not result in an impact on processes
	2	low and will cause a slight impact on processes
	3	moderate and will result in processes continuing but in a modified way
	4	high (processes are altered to the extent that they temporarily cease)
	5	very high and results in complete destruction of patterns and permanent cessation of processes
b) The physical extent	1	the impact will be limited to the site
	2	the impact will be limited to the local area
	3	the impact will be limited to the region
	4	the impact will be national
	5	the impact will be international

Factor	Score	Description
c) The duration, wherein it is indicated whether the lifetime of the impact will be	1	of a very short duration (0 to 1 years)
	2	of a short duration (2 to 5 years)
	3	medium term (5–15 years)
	4	long term (> 15 years)
	5	permanent
d) Reversibility: An impact is either reversible or irreversible. How long before impacts on receptors cease to be evident.	1	The impact is immediately reversible.
	3	The impact is reversible within 2 years after the cause or stress is removed.
	5	The activity will lead to an impact that is in all practical terms permanent.
e) The probability of occurrence, which describes the likelihood of the impact actually occurring.	1	very improbable (probably will not happen.
	2	improbable (some possibility, but low likelihood).
	3	probable (distinct possibility).
	4	highly probable (most likely).
	5	definite (impact will occur regardless of any prevention measures).

The final assessment of the risk, i.e., the significance, of a particular impact is determined through combination of the characteristics described above (refer formula below):

Risk Significance = (Extent + Duration + Reversibility + Magnitude) x Probability

The risk (significance) can then be assessed as low, medium or high as follows:

OVERALL SCORE	SIGNIFICANCE RATING (NEGATIVE)	SIGNIFICANCE RATING (POSITIVE)	DESCRIPTION
4-15	**Very Low**	**Very Low**	Where the impact in negligible
16-30	**Low**	**Low**	Where this impact would not have a direct influence on the decision to develop in the area
31-60	**Moderate**	**Moderate**	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
61-80	**High**	**High**	Where the impact must have an influence on the decision process to develop in the area
81-100	**Very High**	**Very High**	Where the impact would indicate a potentail fatal flaw

It must be reiterated that this SHE Risk Assessment is technical in nature and does not need to comply with the EIA Regulations. The above risk assessment methodology is therefore not a requirement of the EIA Regulations.

2.2. Assumptions, Knowledge Gaps and Limitations

The following assumptions and limitations apply:

- No specific site visit will be undertaken. The level of detail required for assessment of SHE impacts of the BESS SHE RA does not necessitate a detailed inspection of the exact area.
- Only lithium-ion or sodium-ion, redox flow type (typically vanadium chemistry) and molten metal (typically Ambri technology) batteries will be considered in the assessment. The above chemistries have been used for this assessment but alternative chemistry and technologies such as solid state may be considered.
- As they have been more widely used there is more information readily available in the literature on lithium type batteries as opposed to redox flow or molten metal batteries.
- Redox flow battery systems can be containerized but can also be utility scale facilities with electrolyte in tanks within a large building, i.e. not containerised.
- Lithium and molten metal BESS facilities are assumed to be containerized.

3. Description of Project Aspects relevant to BESS SHE RA

The following aspects are relevant to the High-Level BESS SHE Risk Assessment:

- Solid-state (typically lithium based chemistry but may be alternative chemistry):
    - the proximity to occupied residences;
    - the layout to prevent domino effects of fires/explosions between facilities;
    - suitable emergency response during all phases of the project; and
    - suitable end of life plan to be in place.

- Redox flow BESS (assume vanadium for now but may be alternative chemistry):
    - proximity to water courses;
    - suitable secondary spill containment for large tanks of electrolyte;
    - suitable emergency response during all phases of the project; and
    - suitable end of life plan to be in place.

- Molten metal BESS (assume Ambri):
    - safety of personnel due to high temperature liquids;
    - suitable emergency response during all phases of the project; and
    - suitable end of life plan to be in place.

4. Study Area Definition

The Study Area is defined as the area covered by the land parcels where the proposed project will be located (i.e. the full extent of the affected farm properties). The Scoping Buildable Area is the where the actual development will be located, i.e. the footprint containing the solar PV panels and associated infrastructure. The full extent of these properties has been assessed in this study in order to identify sensitivities and no-go areas. At the commencement of this Scoping and EIA Process, the Original Scoping Buildable Areas were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool. As part of this Scoping Phase, the Original Scoping Buildable Areas and study area have been assessed and considered in this report.

Following the identification of sensitivities during the Scoping Phase, the Project Developer will take such sensitivities into account and formulated the Revised Scoping Buildable Areas. The Revised Scoping Buildable Areas will be used to inform the design of the layout and will be further assessed during the EIA Phase. This report is focused on the Original Scoping Buildable Areas as provided.

5. Baseline Environmental Description

The development area is low intensity agricultural land. In the south of the affected properties, outside of the current proposed development area, lies the Berg Rivier and associated irrigated agriculture (refer to specialist aquatic reports). A high voltage power line runs through the development area as does the R399.

6. Issues, Risks and Impacts

The following issues are of consideration:

- Solid State BESS (typically lithium based chemistry but may be alternative chemistry):
    - noxious smoke; and
    - fires/explosions.

- Redox flow BESS (assumed vanadium for now but may be alternative chemistry):
    - suitable secondary spill containment for the large volume of electrolyte.

- Molten metal BESS:
    - protection of personnel from hot surfaces/liquids.

- General:
    - agricultural area – only commercial locations of interest.
    - Infrastructure such as powerlines and public roads.
    - location of farmsteads, rivers and watering holes.

Ideally, due to the possibility of noxious smoke from fires, lithium-ion BESS should be located over 500m from residences, in this case isolated farm facilities/houses or guest lodges that are occupied. If this is not possible, it is noted that the risks are low and advice on mitigative measures should be provided to the farm occupants, e.g. shelter in place indoors. Most of the currently proposed development area (except the north western most corner) is further than 500m from any farm houses and is therefore suitable.

For similar reasons it would be preferable if lithium-ion BESS facilities were located over 150m from major public roads. The current separation of the R399 is more than 100m from the development area. The BESS should be suitably placed within the development area.

Batteries, particularly lithium-ion batteries, do present a fire and explosion hazards to other infrastructure, e.g. power lines, and they should therefore be suitably separated. The currently proposed development areas are over 80m from the power lines and are therefore suitable for BESS locations.

Due to the fact that South Africa is not a water rich country, supplies of water such as drinking water boreholes, as well as other surface water features, should be protected from possible chemical contamination. Should redox flow batteries (such as vanadium) be the chosen technology, it is suggested that the facilities be located a suitable distance away from water courses/sources. Refer to the Aquatic Biodiversity and Geohydrology specialist studies for specific details of separation distances. Ideally the BESS should be placed at least 50 m away from known boreholes and waterpoints, and 100 m away from major surface water features, such as major rivers and wetlands. Based on the current development areas, there appears to be suitable separation from water resources (to be confirmed by aquatic specialist studies).

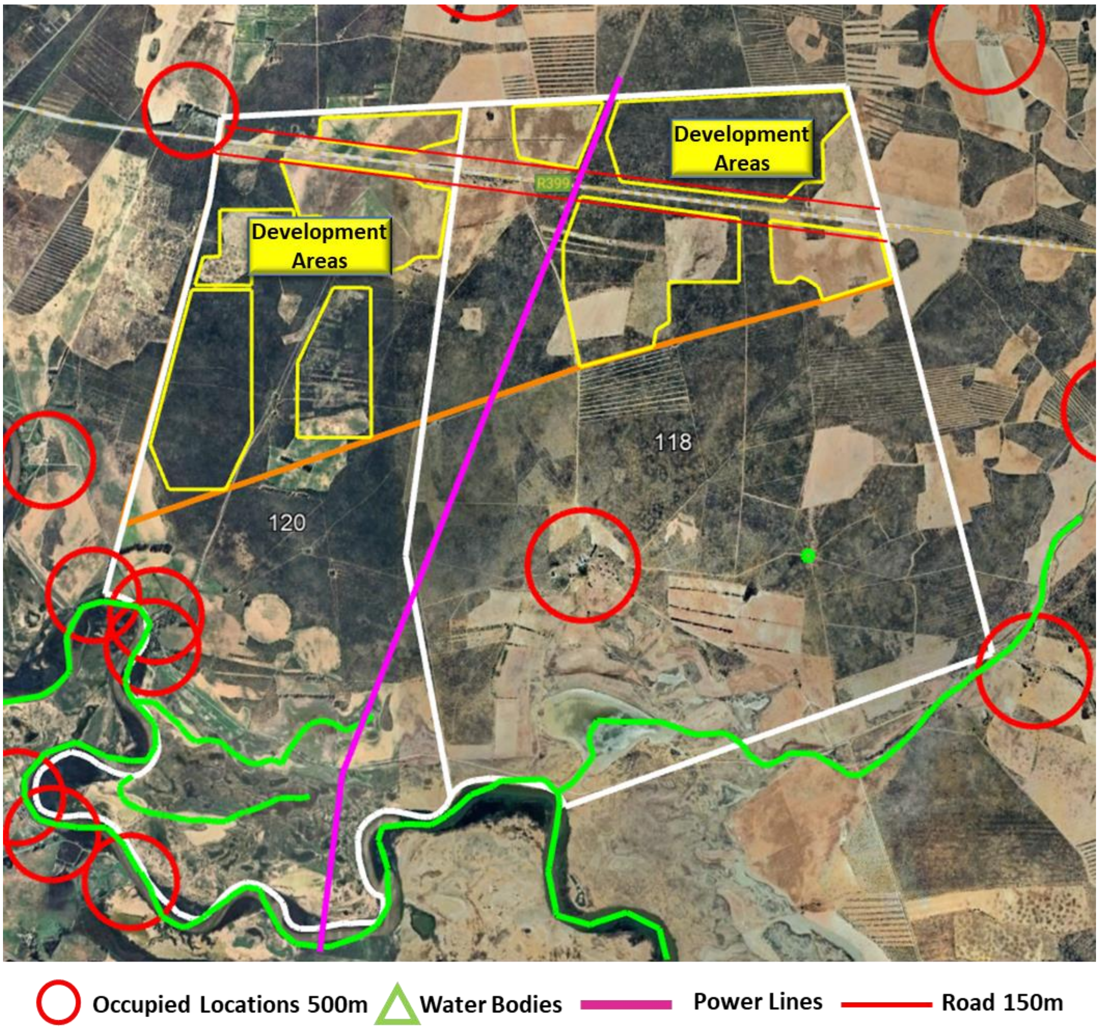

Figure 3: Satellite Image of the area showing the location of isolated farmsteads, obvious water resources (to be confirmed by aquatic study), road etc in relation to the proposed PV infrastructure

7. Scoping Level – Impact Assessment

The BESS SHE RA is not expected to raise any unacceptably high-risk issues, i.e. the BESS facility of either technology type are not likely to be a No-Go option within most of the proposed development area (note separation distances are advised in small sections).

The safety and health risks associated with redox flow batteries (e.g. vanadium) will likely be lower than for the solid state lithium battery type for both employees and members of the public outside the facility. Lithium batteries pose a higher fire and explosion risk as well as the possibility of generating noxious smoke under these circumstances.

The environmental risks of surface aquatic features and groundwater contamination with the redox flow type batteries will likely be higher than for molten metal and solid state batteries, due to the presence of liquids.

8. Statement of the Revised Scoping Buildable Areas

As indicated above, following the identification of sensitivities during the initial Scoping Phase, the Project Developer has considered such sensitivities and formulated the Scoping Buildable Areas, which will be further assessed during the EIA Phase. The Scoping Buildable Areas (apart from small separation distances) are considered suitable from an SHE perspective, as the sensitivities identified above have been taken into consideration.

9. Legislative and Permit Requirements

The BESS must be designed, operated, maintained and decommissioned according to the requirements of Occupational Health and Safety Act 85 of 1993. It is unlikely that accidents at the BESS would lead to catastrophic effects on large numbers of members of the public and therefore neither the of the BESS technologies is likely to lead to the facility being classified as a Major Hazard Installation.

Appendices

Appendix A - Specialist Expertise

CONSULTANT CURRICULUM VITAE

NAME : **DEBRA MITCHELL**

EDUCATION :

BSc Chemical Engineering (Cape Town) 1985

BA Psychology, Economics (UNISA) 1995

MSc Process Safety & Loss Prevention (U. Sheffield UK) 2004 (Distinction)

AFFILIATIONS :

Professional Engineer

Member of SA Institute of Chemical Engineering

ISHECONcc is an Approved Inspection Authority for Major Hazard Installations and for Explosives

SANAS ISO 17020 Technical Auditor

Chairman of SABS TC292 Sub-committee for compilation of SANS1461- MHI RA Standard

WORK EXPERIENCE:

1999 - 2021	Formed Ishecon c.c. with two partners as a management-buy-out of the SHE Consulting Group of AECI Engineering.
1997 - 1999	AECI Engineering Pty (Ltd), Modderfontein. Senior Process Safety Engineer. Risk assessments and Hazard Studies for AECI projects. Also involved in development of safety and risk related training programs.
1996 - 1997	Sasol Synthetic Fuels, Secunda, Senior Environmental Engineer, responsible for initiation of projects and statutory reports.
1991 – 1996	Sastech, Secunda, Lead Process Engineer, Steam and Water Utilities Department, responsible for a team of process engineers compiling process engineering designs and feasibility studies. Seconded to Foster Wheeler UK for 6 months.
1987 – 1991	SAPPI, Ngodwana, Technical Superintendent, responsible for management of a team on an applied research and development effluent recovery pilot plant.
1986 - 1987	Atomic Energy Corporation, Engineer-in-training, process engineering design.

PROCESS SAFETY EXPERIENCE :

1997/2021 *Quantitative Major Hazard Installation Risk Assessments (Initial assessment and updates as required over the years)*

Gauteng:

Holfontein Hazardous Landfill site, Akulu Marchon Sulphonation, Nissan LPG, SAB Rosslyn and Chamdor, Protea Chemicals Wadeville, African Explosives Modderfontein Complex, Sappi Enstra peroxide, Rosslyn Township Development, Crest Midrand, Revlon Isando, Plaaskem, AECI Chloorkop, NECSA.

Natal:

Umgeni water treatment plants, Blendcor, Clairwood Logistics Park, Crematorium gas supply, Crest Chemicals Jacobs, Durban Metro LPG; All chorine installations at swimming pools and sewage plants throughout the Durban area. Ezimbodekweni Township formalisation, Illovo Sugar Merebank, Assmang Cato Works, Shu Powders, Metalichem, Plascon, Unitrans, Transnet Port operations, Back of Port–new harbour, FFS PMB. Umbogintwini Industrial complex: Chemical Initiatives, Experse, Ineos Acrylics, Dulux Paints, Alliance Peroxide, Resinkem, Improchem, Marshalling Yard, Effluent treatment and sea disposal, Bio-products Lysine plant, review composite integrated site risk assessment.

Freestate and Others:

Midland Industrial Complex: Chlorine production, Polyethylene production (old and new plants), Cyanide plant, Peroxide plant, Chlorine derivatives, bulk chlorine road transport, Integrated composite site risk assessment, Omnia Sasolburg complex. Omnia ammonia depots (5). New Hydrogen Peroxide Installation, De Beers Micro Diamond HF facility, Shell fuel depot Kimberly, BHP Billiton LPG Steelpoort.

Cape:

BESS and fuel turbine power generation plant, Fine Chemicals Corporation, Aspen Pharmacare, Protea Chemicals, Kohler Versapac Paarl, Kynoch Milnerton, Johnson Controls PE, Protea Chemicals, Vissershoek hazardous landfill, Crest new chlorine and sulphur dioxide packaging facility, Shell fuel depot Mossel Bay, AECI Coatings, AFROX PE, Gas Turbines and various expansions at PetroSA Mossel Bay, NCP Atlantis.

Integrated Safety, Health and Environmental Risk Assessments

2021 Various (10) Battery Storage facilities in the Northern and Western Cape.
2001 Tzaneen Municipality; all municipal operations (e.g. roads, parks etc).
2001 Dulux Paints; all operations at Alrode Site and at Umbogintwini Site.
2000/2003 Somerset West Industrial Site, Kynoch Gypsum Pipeline
2005/6 Illovo Sugar Merebank Bund Study, Enviroserv Shongweni
2010 - 19 AEL various explosives manufacturing facilities in South Africa and the region.

Hazard and Operability Studies (HAZOP)

2000/2014 SASOL/NATREF Cleans Fuels II,VCM Upgrade, TNP Ex, Skeletal Isom Plant
2005 / 2014 Fine Chemicals Corporation Cape Town – API Expansion. CISA; effluent treatment,
1997/2019 chrome concentrator, Vanadium Recovery
2000/2019 African Explosives; nitrates, bulk emulsion and detonators etc
1997/2019 Rand Water and Biwater – chlorination, ammonia, poly, lime, RO facilities
Other hazops for ERWAT, Industrial Urethanes; Mhlume Sugar, Zinchem, Kynoch Feeds, AEL, ammonia plants, Element 6 HF plant, Omnia HEF, GSK Nairobi and Lagos etc.

Emergency Response Studies

2006 SA Mint Company in Midrand Emergency Plan Evaluation
2006 A1 Grand Prix for 2007 Emergency Plan Evaluation
2015 Atlantis Leather Crusting

	Explosives Risk Assessments
2008/2019	AEL – Emulsion Manufacturing Plants in RSA, Tanzania, Zambia & DRC (6 plants)
2009/2010	AEL - Detonator/shock tube assembly plants Indonesia, UK and South America
2015	SteinMuller Explosive Welding, Wits Explosive Piling
	Hazardous Area Classification Studies
2012	Aspen Pharmacare Olifantsfontein
2011	AEL – Ammonia Plant
2019	Royal Swaziland Sugar Corporation - Distillery
	Auditing
2018	Ferro Dispersions, NCS Resins and FCR Process Safety Management Audits
2019	Puregas Alrode Process Safety Management Audit
2017/2019	ISO 17020 Technical auditing for MHI AIAs at Sasol, AFROX, BIRA, ERM