

	UMQULU WEENKCUKACHA WOLUNTU	UbuNjineli beNyukliya	Ulwakhiwo olutsha lwamandla enyukliya
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Title: **Umqulu weeNkcukacha woLuntu oXhasa iSicelo seLayisenisi ka-Eskom seNdawo yokuFaka iNukliya kwiNdawo i-Thyspunt** Isikhangeli esiNgafani **240-147175950** nezinye:

Enye iNombolo **N/A**
ekungaJoliswa kuyo:

Indawo apho **UbuNjineli beNyukliya**
kuSetyenzwa khona::

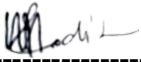
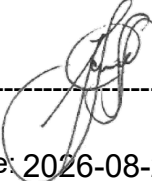
Uhlobo loMqulu:: **PID**

Ukuphinda-phinda: **2a**

Inani lonke **159**
lamaphepha:

Umhla oLandelayo **N/A**
wokuPhinda kujongwe:

Ukuvezwa koHlelo: **Yoluntu**

Ihlanganiswe ngu	Ixhaswa ngu	Uxanduva Lokusebenza	Igunyaziswe ngu
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Date: 2026-08-26	Date: 2026-08-26	Date: 2026-08-27	Date: 2026-08-27

ISISHWANKATHELO SEBHUNGA

I-Eskom Holdings (SOC) Limited ifake isicelo, ngokuhambelana nemigaqo R.927 (imigaqo yokunikezelwa kwelayisenisi kwiindawo zokufakelwa kwenyukliya ezintsha), selayisenisi yendawo yokufakelwa kwenyukliya (NISL) kwindawo yaseThyspunt. Injongo yesicelo se-NISL kukufumana ilayisenisi yeThyspunt njengendawo yenyukliya yokufakelwa kwenyukliya entsha.

Isicelo se-NISL silingana nesicelo semvume yendawo yokuqala (i-ESP) (umlenze wophononongo lweNgxelo yoVavanyo loKhuseleko) eMelika, apho indawo inokunikwa ilayisenisi, ngaphandle koyilo oluthile lwesityalo samandla enyukliya, njengoko kufanelekile ukwakhiwa nokusebenza kwesityalo samandla enyukliya.

Olu xwebhu loLwazi loLuntu (i-PID) lusebenza ukubonelela uluntu ngolwazi malunga nohlalutyo kunye novavanyo oluxhasa isicelo se-Eskom NISL.

Iinkcukacha zoyilo lofakelo lwenyukliya aziyonxalenye yesicelo se-NISL. Sisicwangciso sika-Eskom sokufaka isicelo seelayisenisi zokufakela inyukliya ukuze kwakhiwe kwaye kusetyenziswe ukufakelwa okuninzi kwenyukliya kwindawo leyo, ngelo xesha u-Eskom kuya kufuneka anike iinkcukacha malunga noyilo kunye nolwakhiwo lofakelo. Nangona kunjalo, ukubonisa ukuthotyelwa kweemfuno ze-NNR, phakathi kwezinye izinto, idosi ye-radiological kunye nomngcipheko, kwalandelwa indlela ye-Plant Parameter envelope (PPE). Indlela ye-PPE yindlela eqhelekileyo esetyenziswa kwihlalatho liphela ukuphuhlisa imvume yendawo yokuqala (ESP) (umz. uClinton; uGrand Gulf; uNorth Anna; uVogtle; indawo ye-PSEG kunye neClinch River Nuclear Site e-USA) ngaphambi kokukhetha itekhnoloji ethile ye-reactor, efana nesicelo se-NISL kwiindawo ezintsha ze-reactor ezicetywayo. I-PPE isetyenziswa njengegalelo ekuvavanyeni impembelelo enokubakho kukhuseleko lwenyukliya, imiba yokhuseleko lokusingqongileyo kunye nezicwangciso zokujongana neengxamiseko zenyukliya ngaphandle koyilo lwesityalo esithile senyukliya. Ekubeni Ingxelo Yokhuseleko Lwesiza iThyspunt (i-TSSR) isekelwe kwidatha ethile yendawo, izigqibo ze-TSSR ziqinisekile kwaye kufuneka zisetyenziswe ekuxhaseni ilayisenisi zokufakela inyukliya ezilandelayo njengoko ibonelela ngeseti yeeparameter ezigubungelayo apho ukwamkelwa koyilo oluthile lwendawo ethile kuya kusekelwa khona. Kufuneka kuqatshelwe ukuba ekusebenzisweni indlela ye-PPE, ukubhekisa kwisakhiwo esicetywayo, indawo, okanye iprojekthi akwenzelwanga ukuba kube yimida kwii-reactors njengoko kuxoxiwe ngazo, kodwa kubandakanya naluphi na uyilo olumida yi-PPE.

UKUCHAZWA KWENDAWO

Indawo yase-Thyspunt ime kumazantsi agudle unxweme eMzantsi Afrika, malunga neekhilomitha ezine, empuma ye- Oyster Bay, kwiikhilomitha ezili-12 entshona ye-St. Francis Bay kwakunye namalunga ne- 17,3 eekhilomitha emazantsi e-Humansdorp (imigama ikalwa ukusuka embindini wesiza ukuya kumda wedolophu ekufutshane).

Akukho hola beendlela bakhwelangaphezu kwabanye abanqumla kule ndawo. Owona mgaqo ufikelela kule ndawo yindlelana engalungiswanga eya e-Oyster Bay. Enye indlela igqitha

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umgaqo ongalungiswanga, ophuma usuka emgaqweni wetha u-R330 osuka e-Humansdorp usiya e- St. Francis Bay.

Iindiza zeenqwelo moya kulo mmandla ikakhulu ziindiza zeenqwelo moya ezincinci kunye neendawo zokufika ezingxamisekileyo ezikwiifama. Uninzi lwazo ziindawo ezingabhaliswanga ezisetyenziselwa iinjongo zabucala ezingenazakhiwo okanye izakhiwo. Isikhululo seenqwelo moya samazwe ngamazwe iDavid Stuurman (DSIA) ¹ (85 km empuma) sikwindawo engaphandle kwe-80km yendawo kwaye sesona sikhululo seenqwelo moya sikufutshane nendawo.

Akukho zixhobo zomkhosi ngaphakathi kwe-80 km ukusuka kwindawo.

Akukho mizila kaloliwe esebenzayo kwindawo yendawo.

Izibuko laseGqeberha nelaseNgqura (eCoega), ezikwi-80 km ukusuka kwindawo, zezona zikhulu zezorhwebo kulo mmandla ubanzi.

Izibuko elincinci leenqanawa zokuloba eCape St. Francis, elikwi-13,9 km empuma, line-block water enesitya sangaphakathi seenqanawa zokuloba zorhwebo, kunye neendawo zokumisa iinqanawa zekhonkrithi kunye necandelo elinesiseko se-slipway seenqanawa ezincinci zokuzonwabisa. Okwangoku akukho zicwangciso zokwandisa izibuko.

ISILUMKISO SOKUKHUSELEKA

Indawo yase-Thyspunt iphandwe ngokuphangaleleyo ngokubhekiselele kwiimpawu zonke zendawo ezinokuthi ziphazamisane nokhuseleko ekufakweni kwale nyukliya iphakanyisiweyo ukuba ifakwe okanye iinyukliya eziphakanyisiweyo. Ukongeza, imicimbi ekungenzeka ibe negalelo yeradiyoloji, kwiimeko zenkqubo eziqhelekileyo (which includes Anticipated Operational Occurrences) kunye neemeko zengozi nazo ziye zahlolwa.

Iindlela ezifanelekileyo ezilandela iikhowudi namanqanaba ehlabathi kunye nokhuseleko ziye zalandelwa zaza zenziwa kuko konke. Umzekelo, iimeko zobugcisa neendlela, ikomiti ephezulu yokuqwalasela iinyikima nokuhlola imingcipheko (SSHAC). Indlela yenqanaba 3 iye yalandelwa ukubonisa ukuba kungabakho iinyikima na kule ndawo.

Ngokubhekiselele kwezi zifundo, zithe zenziwa, kuqukumbelwe ngelithi, izehlo zendalo nezenziwa ngabantu zisuka ngaphandle, ezibhekiselele kwindawo i-Thyspunt azikwazi kuvalela le ndawo ekubeni kusekwe iziko lokufaka inyukliya. Izehlo zangaphandle mhlawumbi bekuba zezi:

- Zihlolwe ngaphandle kwemiqathango ukuba zingaqwalaselwa ngakumbi kuba aziyi kuba yingozi kuyilo;
- Kuhlolwe ngokubhekiselele ekubeni isimo siqinisekiswa xa kukhethwa uyilo olukhethekileyo, okanye

¹ Dawid Stuurman Internasionale Lughawe, voorheen bekend as die Port Elizabeth Internasionale Lughawe

- Siza kunikwa imbuyekezo ngokwezi ndlela:
 - Uyilo oluthile lokufakwa kwenyukliya eqikelelwayo okanye
 - Amanathelo okhuseleko lwendawo.

Kuvavanyo lwendawo ukuze kuchongwe impembelelo yayo yemisebe kummandla kwiimeko eziqhelekileyo zokusebenza kunye neemeko zengozu, kufunyenwe uqikelelo olufanelekileyo lokukhutshwa kwezinto zemisebe ezilindelekileyo okanye ezinokubakho, kuthathelwa ingqalelo iimpawu ezigubungelayo zezakhiwo ezicetywayo eziza kwakhiwa kwindawo kunye neempawu zayo zokhuseleko.

Iindlela ezithe ngqo nezingathanga ngqo apho izinto zemisebe zinokufikelela kwaye zichaphazele abantu kunye nokusingqongileyo ziphandwe kwaye zivavanywe, kuthathelwa ingqalelo iimpawu ezithile zengingqi kunye nendawo.

Uvavanyo lwedosi ye-radiological eqikelelweyo lubonisa ukuba idosi esebenzayo yonyaka eqikelelweyo kumntu omeleyo enxulumene nokusebenza okuqhelekileyo kunye neziganeko ezincinci ingaphantsi kwe-0.1 millisievert ngonyaka. Oku kuqinisekisa ukuba idosi yonyaka ingaphantsi komda wedosi kawonkewonke olawulwa yi-NNR kunye namaxabiso othintelo lwedosi yesiza se-1 millisievert ngonyaka kunye ne-0.25 millisievert ngonyaka ngokwahlukeneyo.

Uvavanyo lwedosi radiological doselubonisa ukuba kumthamo ophezulu ocwangcisiweyo wendawo ye-33 000 MWth (10 000MW), idosi iyonke esebenzayo yonyaka yomntu omeleyo enxulumene nokusebenza okuqhelekileyo kunye neziganeko ezincinci yi-0.171millisievert ngonyaka. Eli xabiso lingaphantsi kakhulu komda wedosi kawonkewonke we-National Nuclear Regulator (NNR) we-1 millisievert kunye nomda wedosi yesiza we-0.25 millisievert ngeenjongo zokuthobela umthetho. Ke ngoko, uvavanyo lugqiba kwelokuba ukufakwa kwenyukliya entsha okucetywayo kwindawo yaseThyspunt akubeki mngcipheko kuluntu nakwindalo esingqongileyo.

Uvavanyo lomngcipheko we-radiological lwenziwe kwi-biota engeyoyabantu xa kuthathwa ukuba kukhutshwe izinto kwi- Isikhululo esitsha saMandla eNyukliyi (NNPS) kusetyenziswa i-ERICA Tool. I-ERICA Tool yisoftware eyenzelwe ukubonisa nokuvavanya impembelelo ye-radiation kwi-ecosystem yasekuhlaleni (izityalo nezilwanyana). Uvavanyo lubonisa ukuba izityalo okanye izilwanyana ezivavanyiweyo kuloo ndawo aziyi konakaliswa yi-radiation. Zonke iintlobo ezivavanyiweyo ziwela ngaphantsi komda wovavanyo we-10 $\mu\text{Gy/h}$ nto leyo ethetha ukuba akukho mpembelelo ibalulekileyo elindelekileyo kwizilwanyana okanye kwizityalo.

Uphononongo lweNqanaba lesi-3 loVavanyo loKhuseleko oluNxamisekileyo olwenziwe kwindawo lugqibe kwelokuba umngcipheko wonyaka olindelekileyo wesitishi ngenxa yeengozu ze-reactor kunye neengozu ze-reactor ezibangelwa yingozu yangaphandle kwi-reactor ye-EPR yeeyunithi ezi-6 okanye ukufakwa kwe-reactor ye-AP1000 yeeyunithi ezi-8 kubemi abakwi-radius engama-50 km ejikeleze indawo yi- 3.73×10^{-7} kunye nokufa okungu- 1.06×10^{-7} ngonyaka ngokwahlukeneyo. Oku kungaphantsi kakhulu kwimida yomngcipheko we-NNR yokufa okungu- 5.00×10^{-6} ngonyaka.

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Uvavanyo lokulungela kunye nokusabela kwimeko yengxamiseko lugqibe kwelokuba akukho miqobo ibalulekileyo enokuchaphazela ukwenzeka kokuphuhlisa nokuphumeza isicwangciso sengxamiseko.

ISIPHELO

linkcukacha zohlalutyo nokuhlolwa okwenziweyo ukuhlola ukufaneleka kwendawo yase-Thyspunt kubhalwe kwiNgxelo yoKhuseleko lweNdawo yase-Thyspunt ngokuhambelana nommiselo R927 [1]. Ubume obuqondakalayo bezifundo kunye nokukhuthala oku ebekusenzeka ngako, kuthethelela isicelo se-NISL sika- Eskom. Kuthathwe inkathalo ukuqinisekisa ukuba zonke izinto ezinobungozi, ezinokukhokhelela kutshintso ziyabonwa yaye igalelo lazo lotshintsho elayamene neradiyoloji lubekwe ezantsi apho lufikeleleka kangangoko. Ngako oko kungagqitywa ekubeni:

- Idosi ye-radiological kunye nomngcipheko kuluntu ziya kuba ziphantsi ngokwamkelekileyo kwaye zingaphantsi kwemida yomthetho.
- Akukho zithintelo zibalulekileyo kuphuhliso kunye nokuphunyezwa kwesicwangciso sengxakeko ezichongiweyo.
- Zonke iingozi ezichongiweyo zihlolwe kwaye zihlolwe okanye zinokujongwana nazo kuyilo (lweendawo) zokufakelwa kwenyukliya.
- Amanyathelo okhuseleko afanelekileyo anokubekwa.

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PUBLIC

IZIFINYEZO NEZIFUTSHANE

UFINYEZO-MAGAMA	INKCAZELO
AADQ	Ubungakanani bokukhutshwa okuvumelekileyo ngonyaka
AC	Utshintsho lwe current
AFE	Ukuphindaphinda Konyaka Kokugqithiswa Kwemali
ALARA	Ixabiso Eliphantsi Kangangoko Kunokwenzeka
ASME	Umbutho waseMelika weeNjineli zoomatshini
BLEVE	Ukuqhuma koMphunga oKhulisayo woLwandiso loLwandiso
CAA	Igunya leeNqwelomoya zoLuntu
CCWS	Inkqubo yamanzi okupholisa eCandelo
CED	Umthamo oSebenzayo oQinisekisiweyo
CFR	Ikhawudi yeMigaqo yeSizwe
CGN	Iqela laMandla eNyukliya Jikelele laseTshayina
CHRS	Inkqubo yokususa ubushushu bokuNciphisa
CISF	Indawo yokucina yexeshana ephakathi
CNNC	I-China National Nuclear Corporation
COL	Ilayisenisi eDibeneyo
CP	Imvume Yokwakha
CPR	Isixhobo Sokulungisa Amanzi Esixinzelelweyo SaseTshayina
CSS	Inkqubo Yokutshiza Ugcino
DSA	Uhlalutyo Lokhuseleko Oluqinisekileyo
DSIA	Isikhululo Seenqwelo-moya Samazwe Ngamazwe iDavid Stuurman
EA	Imvume Yokusingqongileyo
ECC	Uqweqwe Olubanzi Lwelizwekazi
EIA	Uvavanyo Lwempembelelo Yokusingqongileyo
EIR	Ingxelo Yempembelelo Yokusingqongileyo
ENEC	iQumrhu laMandla eNyukliya lase-Emirates
EP	Ucwangciso Lwengxamiseko
EPD	Idosimitha Yomntu Ye-elektroniki (EPD)
EPR	Isixhobo Sokulungisa Amanzi Esixinzelelweyo SaseYurophu
EPRI	Iziko Lophando Lwamandla Ombane
EPZ	Indawo Yokucwangcisa Ngengxamiseko
ESP	Imvume Yendawo Yasekuqaleni
EUR	Iimfuno Zoncedo ZaseYurophu
EZ	Indawo Yokungabandakanywa

PUBLIC

UFINYEZO-MAGAMA	INKCAZELO
FAR	Ulawulo Lweenqwelo-moya Zikarhulumente
GAL	Inqanaba Lesenzo Eliqhelekileyo
GIL	Inqanaba Lokungenelela Eliqhelekileyo
GMC	Ukuchazwa Kwentshukumo Yomhlaba
GMPE	I-Equation yokuQikelela iNtshukumo yoMhlaba
GMRS	I-Ground Motion Response Spectrum
GWh	Iyure yeGigawatt
HLW	Inkunkuma eNqanaba Eliphezulu (Inkunkuma evelisa ubushushu ene-radioactive concentration ephezulu ye-radionuclide ende nemfutshane)
HV	I-Voltage ephezulu
HVAC	Ubushushu, ukuVuthela umoya, kunye ne-Air Conditioning
I&C	Izixhobo kunye noLawulo (Inkqubo)
IAEA	I-Arhente yaMandla e-Atomic yeHlabathi
ICRP	IKhomishini yaMazwe ngaMazwe yoKhuselo lweMisebe
IDLH	Iyingozi ngoko nangoko kuBomi okanye kwiMpilo
ILW	Inkunkuma eNqanaba Eliphakathi
INSAG	Iqela leeNgcebiso zoKhuseleko lweNyukliya yeHlabathi
IRP	Isicwangciso seMithombo esiDibeneyo
IRWST	Itanki yokugcina amanzi agciniweyoUkuhlolwa kwangaphakathi
IDP	Mqulu woPhuhliso oDibeneyo
ISI	Ukuhlolwa kweNkonzo
ISO	Umbutho waMazwe ngaMazwe woBumeUvavanyo lwangaphakathi
IST	Uvavanyo lweNkonzo
JPC	Ikomiti yoCwangciso oluHlangeneyo
kA	IiKiloampere
KNPS	Isikhululo saMandla seNyukliya saseKoeberg
Kv	IiKilovolt
LCR	Isicelo soTshintsho lweLayisenisi
LFL	Umda oTshayo ophantsi
LLW	Inkunkuma eNqanaba eliphantsi
LNT	Imodeli yeLinear No-Threshold
LOCA	Ukulahleka kweNgozi yeColiant
LOOP	Ukulahleka kwamandla angaphandle kwesiza
LPZ	Indawo yesenzo soKhuseleko sexesha elide
LRF	Inxalenye enkulu yokukhululwa

PUBLIC

UFINYEZO-MAGAMA	INKCAZELO
LWR	I-Reactor yamanzi akhanyayo
MeV	Ii-Mega electron Volts
MOX	I-Oxide exutyiweyo
mSv	I-Millisievert
MTU	kwiMegawatt-day ngetoni nganye ye-metric yeuranium
MW	I-Megawatt
MWe	I-Megawatt (yombane)
MWh	Iyure ye-Megawatt
MWth	I-Megawatt (eshushu)
MPA	Indawo eKhuselweyo yoLwandle
NECSA	I-South African Nuclear Energy Corporation
NEMA	Umthetho weSizwe woLawulo lokusiNgqongileyo
NIL	Ilayisenisi yoFakelo lweNyukliya
NISL	Ilayisenisi yeNdawo yoFakelo lweNyukliya
NKP	Inqaku eliPhambili leSizwe
NM	IiMayile zeNautical
NNPS	Isikhululo esitsha saMandla eNyukliya
NNR	UMlawuli weSizwe weNyukliya
NNRA	UMthetho weSizwe woLawulo lweNyukliya
NPP	Iinkcukacha zoBugcisa bokuSebenza
NPS	Isikhululo saMandla seNyukliya
OSP	Inkqubo yoPhuhliso loNxhaso lweMisebenzi
OTS	Iinkcukacha zoSebenziso zoBuchwephesha
PID	Uxwebhu lweNkcukacha zoLuntu
PP	Iphepha lendawo
PPE	Iphakheji yeeParameter zeSityalo
PRA	Uhlalutyo Lwenkqubo Yengozi Ngemathuba
PSA	Uhlalutyo lokuKhuseleka lokuThambekileyo
PSHA	Uhlalutyo lweengozi zezemfazwe ngokusekwe kumbandela wobunokwenzeka
PSM	Umphathi weSikhululo samandla
PWR	Umsinga wamanzi ophantsi uxinzelelo
QRA	Uvavanyo loMngcipheko olusemgangathweni
RAP	Isilwanyana kunye Nesityalo esimeleleyo
RB	Isakhiwo seReakhtha
RCCA	Inxalenye yoLawulo lweRod Cluster

PUBLIC

UFINYEZO-MAGAMA	INKCAZELO
RCP	Ipompo yoQandiso lweReeaktor
RCS	Inkqubo yoLawulo lweReactor
RD	Inkqubo yokuTshiza yoKhuseleko
RF	Imvamisa yeRediyo
RG	Isikhokelo soLawulo
RP	Ukukhuselwa kwiRhedyeyishini
RPC	Isatifikethi Sokhuseleko kuMitha
RPP	Indawo yoLawulo lweSitimela
SAB	Gcina Isakhiwo esiNcedisayo
SABS	I-Ofisi yaseMzantsi Afrika Imigangatho
SAMSA	Igunya loKhuseleko lwaseLwandle laseMzantsi Afrika
SANS	Imigangatho yeSizwe yaseMzantsi Afrika
SAR	Ingxelo yoHlalutyo loKhuseleko
SAWS	Inkonzo yeMozulu yaseMzantsi Afrika
SBO	Ukucima kombane kwiSitishi
SC	Icala loKhuseleko
SG	Ijenereyitha yoMphunga
SIS	Inkqubo yokufaka umgquba ekhuselekileyo
SSA	Inkqubo yoKhuseleko lweNkcenkceshelo
SSHAC	Ikomiti yoHlalutyo lweNgozi zeNyikima ePhakamileyo
SSR	Ingxelo yoKhuseleko yeSiza
STP	Isityalo soNyango lwaManzi amdaka
TCA	Indawo yoLawulo lweSihululo
TEDE	Idosi eSebenzayo iyonke elinganayo
TLD	Isikhangelisi seThermoluminescent
TMI	Isiqithi saseThree Mile
TRITON	Ukuqina koThutho kuSebenziswe ngokuSebenza okuxhomekeke kwixesha lokuphela kweNeutronic.
TSSR	Ingxelo yoKhuseleko lweSiza saseThyspunt
μGy/h	IMicroGray ngeYure
UFP	Ichibi leFuel elisetyenzisiweyo
UHRs	I-Spectra yeNgxaki eNye-United States of America
USA	IUnited States yaseMelika
USNRC	IKhomishini yoLawulo lweNyukliya yaseMelika
UV	I-Ultraviolet
VEGP	Isityalo sokuvelisa umbane saseVogtle

PUBLIC

UFINYEZO-MAGAMA	INKCAZELO
W-C	IWolff-Chaikoff
WHO	Umbutho wezeMpilo weHlabathi

IIMPAWU ZESAYENSI

COMPOUND	Inkcazelo
KI	Potassium Iodide
KIO ₃	Potassium Iodate
NIS	Sodium-iodide symporter
CO ₂	Carbon dioxide
UO ₂	Uranium dioxide
mSv	i-milisivert

IINKCAZELO

Igama ebizwa ngalo	Inkcazelo
Ukutsha	Amandla obushushu apheleleyo akhutshwa ngeyuniti nganye yobunzima bepetroli, ngcono ukuba abonakaliswe kwiMegawatt-hour ngekhilogram yeUranium (MWh/kgU) okanye kwiMegawatt-day ngetoni nganye ye-metric yeuranium (MWD/MTU). (Qaphela: iMWh ngamandla obushushu hayi amandla ombane.)
Idosi esebenzayo ezinikeleyo (CED)	The quantity $E(\tau)$ is defined as: $E(\tau) = \sum_T w_T \times H_T(\tau)$.....Eqn 1 Where: $H_T(\tau)$ yidosi elinganayo kwizicubu okanye kwilungu T ngexesha elidibeneyo □ elidluleyo emva kokuthatha into ene-radioactive. w_T yi-tissue weighting factor yezicubu okanye i-organ T. Xa i-□ ingachazwanga ithathwa njengeminyaka engama-50 kubantu abadala kwaye ixesha lokuthathwa kwabantwana libe yiminyaka engama-70.
Isithintelo	Ixabiso elinokwenzeka nelinexulumene nomthombo wedosi yomntu ngamnye (umda wedosi) okanye lomngcipheko womntu ngamnye (umda wengozi) elisetyenziswa kwiimeko zokuvezwa ezicwangcisiweyo njengepharamitha yokwenza ngcono ukhuseleko kunye nokhuseleko lomthombo, kwaye elisebenza njengomda ekuchazeni uluhlu lweendlela zokuphucula. i) Ekubonakalisweni emsebenzini, umda kwidosi yomntu ngamnye kubasebenzi abamiselwe nabasetyenziswa ngababhalisi kunye nabanini mvume ukuseta uluhlu lweendlela zokuphucula ukhuseleko kunye nokhuseleko lomthombo. ii) Ekubonakalisweni esidlangalaleni, umda wedosi lixabiso elinxulumene nomthombo elisekwe okanye elivunyiweyo

PUBLIC

Igama ebizwa ngalo	Inkcazelo
	ngurhulumente okanye ngumbutho olawulayo, kuthathelwa ingqalelo iidosi ezivela kwimisebenzi ecwangcisiweyo yazo zonke imithombo ephantsi kolawulo. iii) Umda wedosi womthombo ngamnye ujolise, phakathi kwezinye izinto, ukuqinisekisa ukuba isixa seedosi ezivela kwimisebenzi ecwangcisiweyo yazo zonke imithombo ephantsi kolawulo sihlala ngaphakathi komda wedosi. iv) Ekubonakalisweni kwezonyango, umda wedosi lixabiso elinxulumene nomthombo elisetyenziswa ekwenzeni ngcono ukhuseleko lwabanakekeli kunye nabathuthuzeli bezigulana eziphantsi kweenkqubo ze-radiological, kunye nokukhuselwa kwamavolontiya aphantsi kokubonakaliswa njengenxalenye yenkqubo yophando lwezonyango. i) v) Umqobo womngcipheko lixabiso elinxulumene nomthombo elibonelela ngenqanaba elisisiseko lokhuseleko kubantu abasengozini kakhulu kumthombo. Lo mngcipheko usebenza malunga nokwenzeka kwesiganeko esingalindelekanga esibangela idosi kunye nokwenzeka komonakalo ngenxa yedosi enjalo. Imiqobo yomngcipheko ihambelana nemiqobo yedosi kodwa isebenza ekuvezweni okunokwenzeka.
Idosi	Umlinganiselo wamandla abekwe yimitha kwindawo ekujoliswe kuyo.
Idosi esebenzayo	Ubungakanani u-E, obuchazwa njengokuhlanganiswa kweedosi ezilinganayo zezicubu okanye amalungu, nganye iphindaphindwe nge-tissue weighting factor efanelekileyo: $E = \sum_T w_T \times H_T \dots \dots \dots \text{Eqn 2}$ Where: H_T lidosi elilinganayo kwizicubu okanye kwilungu le-T kwaye, w_T sisikali sezicubu zezicubu okanye ilungu T.
Ukuphucula	Nayiphi na inkqubo enyusa ngokungekho mthethweni iqhezu le-U-235 kumxube we-Uranium Isotopes ukuya kumanqanaba aphezulu kunalawo afumaneka kwindalo, kuba kwindalo i-U-238 imalunga ne-99,274% kunye ne-U-235 malunga ne-0,720%. Kukho ezinye ii-isotopes ezifana ne-U-234 kunye ne-U-236, kodwa ezi zenza iqhezu elincinci kuphela umz. i-U-234 ibandakanya i-0,005% kuphela. Ibhalansi yenziwe yi-U-232, i-U-233, kunye ne-U-236.
Ipetroli ekhanyiswayo	I-nuclear fuel evezwe kwimitha ye-neutron kwi-reactor yenyukliya, kodwa kungekhona ngokuyimfuneko ukuyila ukutsha.
Ukuqhekeka kwenyukliya	Ukuqhekeka kwenyukliya kwenzeka xa i-nucleus ye-athomu iqhekeka ibe zii-nuclei ezimbini okanye ngaphezulu.
Ilayisenisi yendawo yokufaka inyukliya (NISL)	Imvume yenyukliya yendawo yenyukliya ebekelwe indawo, ukwakhiwa, kunye nokusebenza kwesixhobo esinye okanye ezininzi zenyukliya. Ilayisenisi zenyukliya zomntu ngamnye ziyafuneka kwisixhobo ngasinye senyukliya esakhiwayo kwindawo yenyukliya.
Ukhuseleko Olungenziwanga ziZixhobo	Amandla esixhobo senyukliya okanye inkqubo yokhuseleko okuthintela okanye anciphise iziphumo zeengozi ngokusebenzisa iimpawu zoyilo ezakhelwe ngaphakathi kunye nemithetho yendalo, ngaphandle kwesidingo samandla angaphandle, izixhobo ezisebenzayo, okanye ungenelelo lomntu.

PUBLIC

Igama ebizwa ngalo	Inkcazelo
Amathuba	Ukwenzeka kwesiganeko.
Uvavanyo lomngcipheko onokwenzeka (i-PRA)	Uvavanyo lomgangatho nolwamanani lomngcipheko onxulumene nokusebenza kwezityalo okanye indawo kunye nokugcinwa okulinganiswa ngokwemiba yokwenzeka kwemilinganiselo yomngcipheko, efana nokuphindaphinda kwesigaba sokukhululwa kunye nemiphumo yayo kwimpilo yoluntu [ekwabizwa ngokuba luvavanyo lokhuseleko olunokwenzeka (PSA) okanye uvavanyo lomngcipheko olunobuninzi (QRA)].
Umthamo oqikelelweyo	Umthamo okulindeleke ukuba ufunyanwe ukuba amanyathelo okukhusela acwangcisiweyo awathathwanga.
Ingozi yesalathiso	Ingozi ekhethiweyo egubungela iseti yeengozi ezinokubonwa kwangaphambili kuhlalutyo lokhuseleko (jonga kwi-RG-0011).
Isilwanyana okanye isityalo esibhekiselweyo (i-RAP)	Into ecingelwayo eneempawu zebhayoloji ezisisiseko zohlobo oluthile lwesilwanyana okanye isityalo (njengoko kuchaziwe kwinqanaba le-taxonomic losapho) eneempawu ezichaziweyo ze-anatomical, physiological kunye nembali yobomi. I-RAP ingasetyenziselwa iinjongo zokunxulumanisa ukuvezwa kwidosi kunye nomthamo kwimiphumo, yolo hlobo lwesidalwa esiphilayo.
Umntu omeleyo	Umntu, oza kuhlala engumntu ocingelwayo, ufumana umthamo omele abantu abachaphazeleka kakhulu kuluntu. Umntu omeleyo ulingana, kwaye uthatha indawo yenani eliqhelekileyo leqela elibalulekileyo.
Umngcipheko	Ibhekisa kwiziphumo zesiganeko, njengoko kuboniswa yi-"risk triplet" ephendula le mibuzo mithathu ilandelayo: • Yintoni enokwenzakala? • Inokwenzeka kangakanani loo nto? Kwaye • Zithini iziphumo ukuba zenzeka?
Ipetroli echithiweyo okanye esetyenzisiweyo	I-nuclear fuel efakwe kwi-nuclear reactor ukuya kwinqanaba apho i-fuel ingasasebenzi ekuqhubekeni ne-nuclear reaction. I-fuel isuswa kwi-reactor core kwaye igcinwe phantsi kwamanzi kwiindawo zokugcina kwi-fuel pools ezichithiweyo..
Iziphumo zeStochastic	Ezo ziphumo apho amathuba okuba kwenzeke ayanda ngedosi, apho kungekho mda apho ziya kwenzeka khona.
Igama lomthombo	Amaqhezu achaza inxenye ye-radionuclide inventory kwi-reactor ekuqaleni kwengozi ekhutshelwa kwindalo esingqongileyo. Kwakhona kuqukwe kwigama lomthombo kukuphakama kokuqala, amandla, kunye nexesha lokukhululwa.

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- [2] Mgaqo-nkqubo weZilwanyana zasehlathini, uLwandle kunye neNdalo iMvelo, 2025. Isigqibo seSicelo sokungavumelani: Izicelo zokuphikisa isigqibo sokunika Ugunyaziso lweNdalo ngu-Eskom Holdings (SOC) Ltd sokwakhiwa, ukusebenza kunye nokurhoxiswa kweSikhululo seAmandla eNyukliya esikwiDuynefontyn.
- [3] ICandelo leZibane kunye neeMveliso zeMihlaba, 2005. Umgao-nkqubo noBudlelwane boLawulo lweMveliso eziRhatywayo e-Republiki yaseMzantsi Afrika.
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1. INJONGO NOMDA

Iinjongo zalo mqulu kukunika amalungu oluntu iinkcukacha ngokubhekiselele kubume bokufaka isicelo selayisenisi yendawo yokufaka inyukliya (NISL) kwindawo yase-Thyspunt. Umqulu unika ubume beprojekthi ngokubanzi, inkcazelo yeengozi ezingabakho ngenxa yokuvezwa kwimitha ekrazulayo, iinkcukacha ezibanzi zenqanaba lohlobo lobuchwepheshe obunokuba kuloo ndawo, kuqwalaselwa iipharamitha ezikhethekileyo ukulungelana neempawu zendawo, inkcazelo yendawo kunye nokuthethelelwa kokufaneleka kwayo, izinto ezixhasa imeko yokhuseleko, ukuhlolwa kokuba lungenzeka na uphuhliso nokuqhutywa kwesicwangciso songxamiseko, iinkcukacha malunga nolawulo lwenkunkuma kunye nokupheliswa kwayo, inkcazelo ngamanyathelo othutho kunye nokunikwa kothutho olukhuselekileyo kunye nezinto ezinemitha ye-athom.

Isicelo se-NISL sinqunyelwe kuvavanyo lokufaneleka kwendawo yokufaka izixhobo ezintsha zenyukliya kwaye oku kwenziwa ngokuhambelana nemigaqo yokunikezelwa kwelayisenisi kwiindawo zokufakela izixhobo ezintsha zenyukliya (uMgaqo R.927) [1]. Le nkqubo yenza ukuba umfaki-sicelo acele imvume xa kungekho kukhethwa koyilo oluthile ngokuqwalasela i-envelope yokufakela izixhobo zenyukliya ekunokwenzeka ukuba zibekwe kwindawo leyo (ekwaziwa ngokuba yindlela yePlant Parameter Envelope (PPE)). Le ndlela isetyenziselwa ukubonelela ngesiphelo kwimiba yokufakela izixhobo kwangethuba apho isigqibo malunga noyilo oluthile lwe-reactor sisasebenza. Njengenxalenye yesicelo, ukuthobela kufuneka kuboniswe kwiNational Nuclear Regulator (NNR) ukuba izinto ezifanelekileyo zokufakela izixhobo zichazwe ngokufanelekileyo kwaye zivavanywe ukujongana nemiba yokhuseleko kwaye idosi kunye nomngcipheko kuluntu oluvela kuzo zonke izixhobo zenyukliya ziya kuthobela imigangatho ye-NNR kwaye zibe phantsi kangangoko kunokwenzeka (ALARA).

Subsequent kwe-NISL, ilayisenisi yokufaka inyukliya (i-NIL) imele imvume ephambili yokwakha, ukusebenza, ukugcinwa, ukususwa kongcoliseko, kunye nokususwa kofakelo lwenyukliya ngokusekelwe kuyilo oluthile. I-PID ehambelanayo yesicelo esithile se-NIL iya kuphuhliswa xa isicelo se-NIL senziwe.

Olu xwebhu luhlaziyo lohlahaziyo lwangaphambili luqwalasela uhlaziyo lwakutshanje lolwazi lwesiza kunye neendawo ezisingqongileyo.

2. IMVELAPHI

U-Eskom ifake isicelo se-NISL ngokuhambelana nomgaqo-nkqubo wamandla enyukliya ka-2008 [1], oyalela i-Eskom ukuba iqinisekise ukuba iindawo zokwakha izityalo zenyukliya zexesha elizayo ziyafumaneka, zikhuselekile, zikhuselwe kwaye zigunyazisiwe ngaphambi kokuba uxinzelelo lophuhliso luzenze zingafaneleki okanye zidale ubunzima obukhulu bokhuseleko kunye nocwangciso olungxamisekileyo.

Le sicelo se-NISL sisiqalo se-NIL sokwakha nokusebenzisa isikhululo samandla enyukliya kwindawo yaseThyspunt. Isicelo se-NISL (ukuba sivunyiwe), sivumela i-Eskom ukuba iqalise imisebenzi yendawo kwangoko njengoko kuqulethwe kwiphepha lesikhundla (PP-0009): imvume yoFakelo lweNyukliya [24].

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2.1. Iindawo Zeprojekthi Ezifanayo Zenyukliya KwiHlabathi Jikelele

Ukubeka indawo yofakelo lwenyukliya yinkqubo ebalulekileyo kuba inokuchaphazela kakhulu iindleko, ukwamkelwa luluntu, kunye nokhuseleko lofakelo kulo lonke ixesha lokusebenza kwalo.

Inkqubo yokufaka indawo yenyukliya yinkqubo echazwe kakuhle. Amazwe ahlukeneyo aqalise iinkqubo zokubeka indawo, afumana ulwalathiso kwiimpapasho ze-International Atomic Energy Agency (IAEA) ezifana ne-IAEA's SSG 35 (*Uphando lweSayithi kunye noKhetho*) [17], NG-T-3.7 (*Ukulawula Imisebenzi yokubeka indawo yeZityalo zaMandla eNyukliya*) [20], SSR-1 (*Uvavanyo lweSayithi loFakelo lweNyukliya*) [19], isikhokelo sokufaka indawo se-Electric Power Research Institute (EPRI) [8] kunye ne-United States Nuclear Regulatory Commission (USNRC) 10 CFR Part 100 [39]; 10 CFR Part 51 [40]; 10 CFR Part 52 [41], kunye nabanye.

Ngokwe-IAEA [17], kukho iinkqubo ezimbini ezinxulumene nokuqwalaselwa kokhuseleko kwindawo yokufakelwa kwenyukliya, oko kukuthi, inkqubo yokubeka kunye nenkqubo yokuvavanya indawo. Ukubeka yindawo yinkqubo yokuhlola nokukhetha indawo efanelekileyo yokufakelwa kwenyukliya, ngelixa inkqubo yokuvavanya indawo ichazwa njengohlalutyo lwezinto kwindawo enokuchaphazela ukhuseleko lwesakhiwo okanye umsebenzi kuloo ndawo. Ngoko ke, uvavanyo luyaqhubeka kulo lonke ixesha lokusebenza kokufakwa, kunye nezinto ezifanelekileyo ezigutyungelwe kwingxelo yokugqibela yohlalutyo lokhuseleko ukuze kuthathelwe ingqalelo utshintsho kwiimpawu zendawo, ukufumaneka kwedatha nolwazi, iirekhodi zokusebenza, iindlela zomthetho, iindlela zovavanyo kunye nemigangatho yokhuseleko.

Ngokutsho kwe-IAEA [17], "kwiiMerika ezininzi, ukubeka indawo ngumsebenzi ongalawulwayo kwaye akukho layisenisi ifunekayo". Imisebenzi yovavanyo kunye nokulungiselela indawo ngokubanzi ichazwa kwaye ilawulwa ngumlawuli wokhuseleko lwenyukliya. Ngokubanzi, izinto zovavanyo lwendawo kwi-IAEA SSR-1 [19] ziqwalaselwa kuwo onke amazwe, nangona ziqhele ukutolikwa ngokwendawo. Kwakhona kuyimfuneko yokwenza uvavanyo lokusingqongileyo ukujongana nempembelelo enokubakho yesikhululo samandla kwindawo ejikelezileyo kunye nempembelelo yendawo kunye nendawo ejikelezileyo kwisikhululo samandla.

Emelika, isicelo selayisenisi yendawo senzeka phantsi kwesicelo semvume yendawo yokuqala (ESP). Ngokukhupha i-ESP, iKhomishini yoLawulo lweNyukliya yase-US (NRC) ivuma indawo enye okanye ezingaphezulu zesikhululo samandla enyukliya, ngaphandle kwesicelo semvume yokwakha okanye ilayisenisi edibeneyo.

Inkqubo ye-ESP yenzelwe ukusombulula imiba ebalulekileyo yokufaneleka kwendawo kwangethuba ngaphambi kokuba kuthathwe isigqibo sokwakha iziko lamandla enyukliya. Phantsi kwe-10 CFR 52 [41], i-ESP inokukhutshwa ngokwahlukileyo kuyo nayiphi na enye inyathelo lelayisenisi ye-NRC. Ezi mvume zisebenza ixesha eliphakathi kweminyaka elishumi ukuya kwamashumi amabini kunye nemigaqo yokuhlaziywa iminyaka elishumi ukuya kwamashumi amabini eyongezelelweyo. Imicimbi yelayisenisi ye-ESP isonjululwa ngokugqitywa ngexesha lenkqubo yokuphononongwa kwe-ESP kwaye ayiphinde ihlolwe nakweyiphi na inyathelo lelayisenisi elilandelayo elibandakanya indawo evunyelweyo.

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Injongo yesicelo se-ESP kukubeka ecaleni indawo ecetywayo yokuvelisa amandla kwixesha elizayo.

Inkqubo ye-ESP equka uluhlu lweedizayini ze-reactor ivumela iinkampani ukuba zikhethe uyilo olufanelekileyo xa kusenziwa isigqibo sokuqhubeka nesityalo esitsha. Ngokusebenzisa ingcamango yePlant Parameter Envelope (PPE), ukufaneleka kwendawo kunokuvavanywa ngokusekelwe kwinkcazo yesityalo ngokubanzi equka iimpawu zoyilo ezahlukeneyo.

I-NRC ikhuphe ii-ESP kwiindawo ezininzi, oko kukuthi, indawo kaClinton ESP (2007) [50], indawo kaGrand Gulf ESP (2007) [51], indawo kaNorth Anna ESP (2007 kwaye ngo-2013, i-ESP Amendment ehlaziyiweyo) [52], indawo kaVogtle ESP (2009) [53], indawo kaPSEG ESP (2016) [54] kunye nendawo kaClinch River ESP (2019) [55]

Kuzo zonke ezi zicelo, ngaphandle kwendawo yeVogtle ESP, ii-reactor ezithile azikhethwanga. Ulwazi lobuchwephesha oluvela kwiindlela ezahlukeneyo zoyilo lwe-reactor olusetyenzisiweyo lusetyenzisiwe ukuphuhlisa iiparameter zomda ezenzelwe ukugubungela ukuchazwa kwesakhiwo esicetywayo esifunekayo ukuvavanya ukufaneleka kweendawo zokwakha nokusebenza kwesikhululo samandla enyukliya kwixesha elizayo.

3. IINKCUKACHA ZALOWO UFAKA ISICELO

Amagama apheleleyo alowo ufaka isicelo	Eskom Holdings SOC Limited
Idilesi yendawo yokuhlala	Megawatt Park Maxwell Drive Sunninghill 2157
Inombolo yobhaliso yeenkampani	2002/015527/30
Umhla wokudityaniswa	2002
Idilesi ebhalisiweyo	P.O. Box 1091, Johannesburg, 2000
Idilesi ekucelwa ukufakwa kuyo inyukliya	Indawo iseMpuma-Koloni phakathi kweedolophu i-Humansdorp (iikhilomitha ezi- 17,3 emantla), kunye ne-St. Francis Bay (iikhilomitha ezili- 12 km empuma) kunye ne- Oyster Bay (iikhilomitha ezi 4 entshona),yavalelwa ngamazantsi olwandle i-Indian Ocean.
Iinkcukacha zayo nayiphi indawo okanye iinkampani ezisondelele kule ndawo	I-Eskom Holdings SOC Limited yekarhulumente ngokupheleleyo.
Iinkcukacha zokubandakanyeka kwamanye amazwe okanye ulawulo lokufakelwa kwenyukliya ziinkampani/oorhulumente bamanye amazwe	N/A

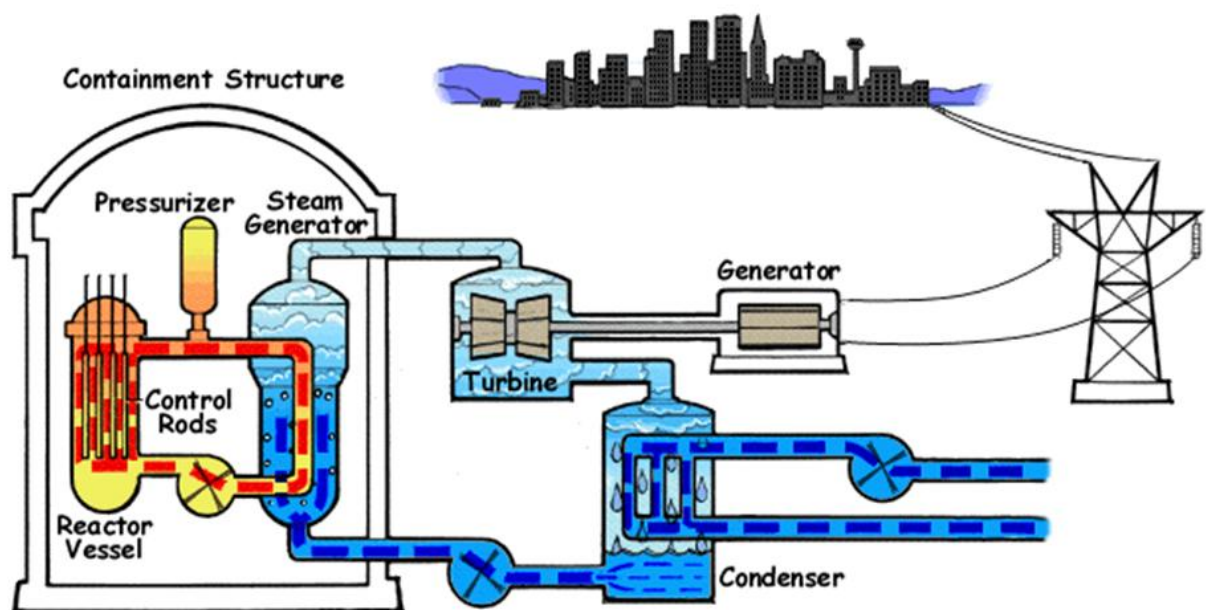
4. INKCAZELO NGEPROJEKTHI

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4.1 Indawo Yophehlo Eceliweyo

I-Eskom ayikasenzi sigqibo malunga noyilo oluthile lwe-reactor oluza kubekwa kwindawo yaseThyspunt, nangona kunjalo, iteknoloji ye-pressurized water reactor (PWR) (jonga Umfanekiso 1) ikhethwe ngokuhambelana noMgaqo-nkqubo wamandla eNyukliya waseMzantsi Afrika [6] njengohlobo lwe-reactor olucetywayo oluza kusetyenziswa. I-PWR isebenzisa amanzi alula njengesibandisi kunye nomlawuli. I-Eskom ibisoloko isebenzisa olu hlobo lwe-reactor ngokukhuselekileyo kangangeminyaka engaphezu kwama-40 kwiSitishi saMandla eNyukliya saseKoeberg (KNPS) kwaye ke ngoko iqhelene nale teknoloji. Iteknoloji ye-PWR esetyenziswa kwi-KNPS yayisekelwe kuyilo lwe-Westinghouse yase-USA kwaye yakhiwa yi-Framotome, inkampani yaseFransi.

U-Eskom ikwaqalise ngempumelelo inkqubo yokwandiswa kwelayisenisi ye-KNPS, apho iCandelo 1 ligunyazisiweyo ukusebenza ixesha elide ngo-2024 kunye neCandelo 2 ngo-2025.[31] Le mpumelelo ibonisa ukuqina, ukuthembeka, kunye nokhuseleko lwexesha elide lwe-KNPS. Ukuvunywa okuqhubekayo kolawulo lwemisebenzi ye-KNPS kubonisa ukuzithemba kubuchule be-Eskom bokusebenzisa ngokukhuselekileyo kunye nokugcina izibonelelo zenyukliya ngokuhambelana nemigangatho yamazwe ngamazwe.

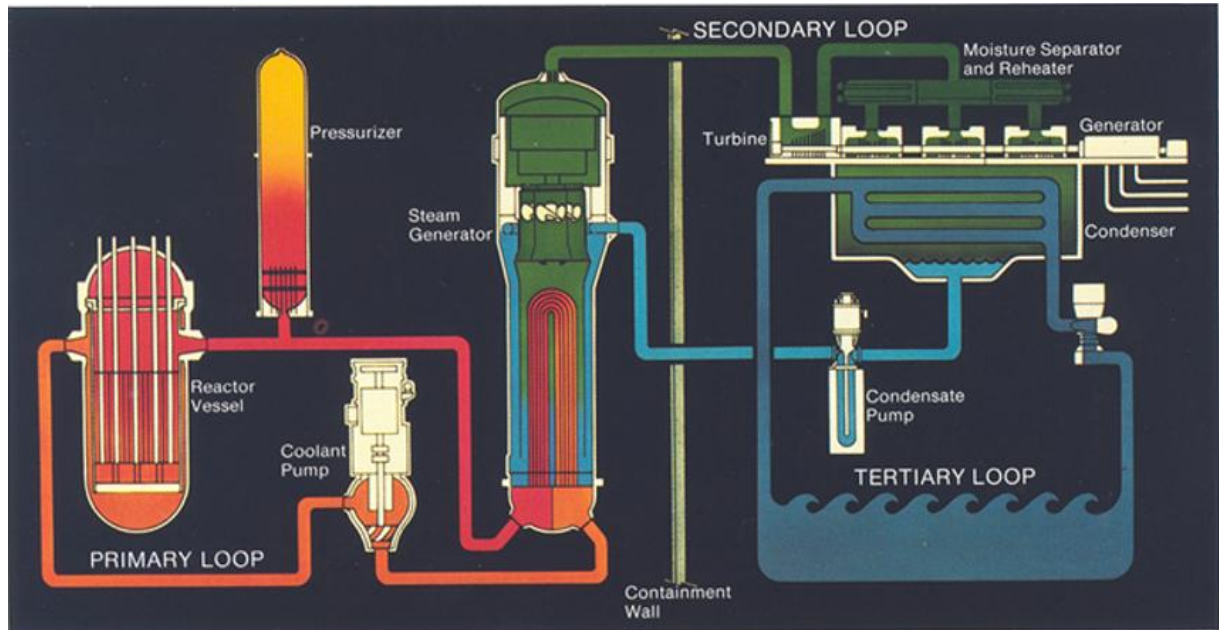


Umfanekiso 1: Umzobo oqhelekileyo wombane wamanzi ocekwe ngoxinzelelo [43]

I-PWR eqhelekileyo yenziwe ngenkqubo yeeluphu ezintathu (Oyintloko Wokuqala, Umjikelo Wesibini ne Umjikelo Wesithathu) apho iinkqubo zahlulwe khona njengoko kubonisiwe kuMfanekiso 2 ngokuxubana okuncinci phakathi kwamanzi eenkqubo ezikufutshane.

Inkqubo yeeluphu ezintathu inika uhlehlengiso, oko kuthetha ukuba ukuba iluphu enye ifumana impazamo okanye kufuneka ihlukaniswe, iluphu eziseleyo zinokuqhubeka nokususa

ubushushu. Kwiimeko apho iluphu enye ifumana ukungasebenzi kakuhle njengokungasebenzi kakuhle kwepompo okanye ukuvuza, uyilo lunciphisa amathuba okuba ingxaki iya kuchaphazela ezinye iiluphu.



Umfanekiso 2 Uqwalaselo lweenkqubo ze-PWR [57]

Iyunithi nganye ye-reactor ineqithi senyukliya, isiqithi se-turbine, izakhiwo zokungenisa amanzi kunye nokukhupha amanzi, kwaye kwezinye iimeko, inqaba yokupholisa. Iindawo eziphambili zeqithi senyukliya zezi:

- isakhiwo se-reactor (RB), esikwabizwa ngokuba yi-containment. Siqulathe i-reactor kunye nazo zonke ii-loops ze-coolant ezinxinzelelweyo kunye nenxalenye yee-loops kunye neenkqubo ezifunekayo ekusebenzeni nasekukhuselekeni kwe-reactor; sisakhiwo esiqinileyo sokuvuza, esigcina uxinzelelo esigcina i-radioactivity ekhutshwa yi-core kwimeko engalindelekanga yengozi kwaye sikhusele inkqubo ye-reactor kwiziganeko zangaphandle. Ngexesha lokusebenza okuqhelekileyo i-RB igcinwa phantsi koxinzelelo olubi. Inkqubo ephambili inee-generator ezintathu zomphunga, iipompo ezintathu ze-reactor coolant, i-pressuriser, kunye nesitya soxinzelelo se-reactor, esigcina i-nuclear fuel.
- Isakhiwo se-fuel, esigcina izibonelelo zokugcina nokuphatha i-fuel entsha (ngaphambi kokufaka kwi-reactor) kunye ne-fuel esetyenzisiweyo (esusiwe kwi-reactor). Isakhiwo se-fuel sikwaqulathe izixhobo zenkqubo yokupholisa nokucoca

ichibi le-fuel kunye nenkqubo yamanzi okutya okungxamisekileyo kwe-generator yomphunga.

- Amagumbi ezixhobo zombane, aqulathe zonke iindlela zokulawula iyunithi (igumbi lolawulo kunye nezibonelelo zokusebenza, izixhobo zamandla ombane, kunye nenkqubo yezixhobo kunye nolawulo [I&C]).
- Isakhiwo esincedisayo senyukliya esigcina iinkqubo ezincedisayo ezifunekayo ekusebenzeni okuqhelekileyo kwe-reactor kunye neenkqubo zokhuseleko ezixhasayo. Esi sakhiwo sigcina izixhobo zenkqubo yokulawula iikhemikhali kunye nomthamo, inkqubo yokucubungula inkunkuma yegesi, inkqubo yokucubungula ukungcola kwe-reactor, iinkqubo zokhuseleko lwe-reactor, kunye nenkqubo yokuphinda usebenzise i-boron.
- Izakhiwo ezibini ezahlukeneyo ngokwendawo, nganye inejenereyitha yedizili (umbane oxhasayo ongxamisekileyo).

Ekubeni iinkcazo ezineenkcukacha zesityalo esicetywayo zingakafumaneki, iimpawu ezibalulekileyo zoyilo lwe-PWR ekufuneka ziqwalaselwe ziquka:

- Uyilo oluqhelekileyo lohlobo lwesityalo ukuze kukhawuleziswe ilayisenisi, kuncitshiswe iindleko zemali, kwaye kuncitshiswe ixesha lokwakha.
- Uyilo olulula noluqinileyo, olwenza isityalo sibe lula ukusebenza kwaye singabi sesichengeni sokuphazanyiswa kokusebenza;
- Ukufumaneka okuphezulu kunye nobomi obude bokusebenza - ngokuqhelekileyo ngaphezulu kweminyaka engama-60;
- Amathuba ancitshisiweyo eengozi zokunyibilika kwe-core;
- Ukunyaniseka okuphezulu kokugcinwa;
- Impembelelo encinci kwindalo esingqongileyo;
- Ukutsha okuphezulu ukuze kuphuculwe ukusetyenziswa kwepetroli kunye nokunciphisa inani lenkunkuma; kunye
- Izifunxi ezitshayo ukwandisa umjikelo wokusebenza kwepetroli.
- • Iindawo zoCwangciso lweNgxakeko ezithobela iimfuno zolawulo lwe-NNR.

Ezi mpawu ziphawuleka kwiitekhnoloji ze-PWR zangoku (ezaziwa ngokuba yi-Generation III kunye ne-III+ designs).

4.2 Uyilo Lwe-Generation III/ III+PWR

Ii-reactor zeSizukulwana III kunye III+zisebenzise amava oshishino kwiminyaka embalwa edlulileyo, kwaye kufakwe uphuculo oluninzi kuyilo lwazo. Ezi zakhiwo ziquka itekhnoloji yamafutha ephuculweyo, zisebenza kakuhle kakhulu kubushushu, iinkqubo zokhuseleko eziphuculweyo kakhulu (kubandakanya ukhuseleko lwenyukliya olungasebenziyo) kwaye zinezakhiwo ezisemgangathweni zokugcinwa okuncitshisiweyo. Zonke iintlobo zee-reactor

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ezihlengabezana neemfuno ezingentla ziya kuqwalaselwa ukuba ukuthengwa kwenyukliya kunikwe imvume kwixesha elizayo. Uyilo lweSizukulwana III kunye neSithathu+ oluqondwayo ukuba lukwimarike ngoku luquka (kodwa alupheleli apho) iWestinghouse AP1000, iKorean APR1400, iChinese HPR1000, iFratome's EPR, kunye neRosatom's VVER1000. Umahluko ophambili phakathi kwezi zityalo kunye neKoeberg Nuclear Power Station unikwe kwi ltheyibhile 1 kwaye inkcazo emfutshane yetekhnoloji nganye inikwe ngezantsi:

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Itheyibhile 1: Uthelekiso lweempawu eziphambili zeZicwangciso eziKhokhelwayo zePWR eziyaziwayo

Uphawu	Koeberg (reference)	AP1000	APR1400	HPR-1000	EPR	VVER1200
Umpuhlisi	Framatome	Westinghouse/ Mitsubishi	Dosam (KHNP)	Iqela le-China General Nuclear Power (CGN) kunye ne-China National Nuclear Corporation (CNNC))	Framatome	Rosatom (ASE)
Amandla obushushu angundoqo (MWth)	2 775	3 400	3 983	3 160	4 250	3 200
Amandla obushushu e-NSS (MWth)	2 790	3 415	4 000	3180	4 500	3 212
Umbane ophumayo (MWe)	900	1 117	1 400	1 185	1 600 – 1 700	1 082
Ukusebenza kakuhle kwezityalo (%)	32	35,6	35	~38%	37	34.5
Ubomi boyilo lwezityalo (iminyaka)	40	60	60	60	60	60

Uphawu	Koeberg (reference)	AP1000	APR1400	HPR-1000	EPR	VVER1200
Inani leeluphu	3	Imilenze eshushu emi-2/imilenze ebandayo emi-4	4	3	4	4
Uluhlu lwezikhonkwane zokuhlanganisa ipetroli	17x17	17x17 isikwere	16x16 isikwere	17x17 isikwere	17x17 isikwere	I-Hexagonal
Inani leendibano zamazitha kwisiseko ngasinye	157	157	241	177	241	163
Enrichment limits (%)	4,95	4,80	3,80	~4.45	5 or MOX	4,69
Inani leejenereyitha zomphunga nge- reactor nganye	3	2 enepitshi engunxantathu	2 enepitshi engunxantathu	3	3 enepitshi engunxantathu	4 ulungiselelo lwendlela
Uyilo lweejenereyitha zomphunga	Ithe nkqo	Ithe nkqo	Ithe nkqo	Ithe nkqo	Ithe nkqo	Ithe tyaba
Iimpompo zokupholisa ze- reactor	3	4	4	3	4	4

4.2.1 AP1000

I-AP1000 yi-PWR ephucukileyo eyenziwe yiWestinghouse Electric Company. Yinguqulelo enkulu yoyilo lwe-AP600 eyahlolwa kwaye yaqinisekiswa yi-US NRC ngo-2005 kunye nee-AP1000 ezilishumi elinesibini ezisebenza okanye ezisakhiwayo ngoku. Ezine zisebenza eTshayina, ezimbini kwiSanmen Nuclear Power Station kunye nezimbini kwiHaiyang Nuclear Power Plant. Ukusukela ngo-2024, ezinye ezi-6 zisakhiwa eTshayina. Ezinye ezimbini zisebenza kwiVogtle Electric Generating Plant, kunye neVogtle 3 efike kwi-intanethi ngoJulayi 2023 kunye neVogtle 4 ngo-Epreli 2024 [44].

ITshayina okwangoku iphuhlisa iinguqulelo eziphucukileyo kwaye inamalungelo ayo elungelo lomenzi. Ukwakhiwa okungakumbi eTshayina kuya kusekelwe kuyilo lwe-CAP1000 kunye ne-CAP1400 oluguquliweyo kunye noyilo lwe-HPR1000.

I-AP1000 sisityalo esinemijikelo emibini esinenkqubo yokupholisa i-reactor equlathe iisekethe ezimbini zokudlulisa ubushushu, nganye ineenereyitha yomphunga, iipompo ezimbini zokupholisa i-reactor ezifakwe ngqo kwijenereyitha yomphunga, ngaloo ndlela kuphelisa imibhobho phakathi kweepompo kunye nejenereyitha yomphunga, umlenze omnye oshushu kunye nemilenze emibini ebandayo ye-reactor ejikelezayo. Ulwakhiwo olulula lwenkxaso lweenkqubo eziphambili lunciphisa ukuhlolwa okusemsebenzini kwaye luphucula ukufikelela kulondolozo.

I-AP1000 inenjongo yokunciphisa ingozi enkulu eyokuqinisekisa ukusebenza okuqhubekayo kogcino xa kwenzeka ingozi ebangela ukonakaliswa okukhulu kwesakhiwo se-reactor. Imisebenzi yokhuseleko lwe-reactor ifezekiswa kusetyenziswa iinkqubo ezingasebenziyo kuphela, akukho zipompo ezisebenzayo, akukho mandla atshintshanayo, amanzi okupholisa, ubushushu, umoya, kunye ne-air conditioning (HVAC), kunye ne-I&C.

Iimpawu ezithile zoyilo zifakiwe ukugcina nokuzinzisa undoqo onyibilikisiweyo ngaphakathi kogcino kunye nokunciphisa iziphumo zokusingqongileyo ezinokuphazamisa amandla okugcina imveliso yayo yokuqhekeka. Ezi mpawu zoyilo zibonelela ngokunciphisa okungafunekiyo nokuhlukeneyo kweziganeko ezinzima kwimeko engalindelekanga yengozi enkulu. Ezi mpawu ziquka inkqubo yokunciphisa uxinzelelo oluzenzekelayo lwe-reactor coolant, ukukwazi ukugcwala umngxuma wesitya se-reactor, i-hydrogen igniters kwi-containment enkulu eyomileyo, kunye nenkqubo yokupholisa i-passive containment. Ezi mpawu zoyilo zisebenza ukugcina ukuthembeka kwenkqubo ye-reactor coolant, ukuthintela ukunyanzeliswa okugqithisileyo kwe-containment kwi-hydrogen detonation okanye i-deflagration, kunye nokususa ubushushu kwi-containment. Ezi mpawu zokunciphisa zigcina amandla aphantsi kakhulu okukhululwa kwemveliso ye-fission kwi-containment ye-AP1000.

I-AP1000 yenzelwe ukuqwalaselwa kwendalo njengento ephambili. Ukhuseleko loluntu, abasebenzi bezityalo zamandla, kunye nempembelelo kwindalo esingqongileyo kujongwane nayo ngolu hlobo lulandelayo:

- Ukukhutshwa kokusebenza kuncitshisiwe ziimpawu zoyilo.
- Iinjongo eziqatha zokuvezwa kwimitha yabasebenzi zimiselwe kwaye zaneliswa.
- Ubungakanani benkunkuma yemitha iyonke buncitshisiwe.
- Eminye inkunkuma enobungozi (engeyiyo imitha) incitshisiwe.

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4.2.2 APR1400

I-Advanced Power Reactor 1400 (APR1400) yi-reactor yamanzi enyukliya ephucukileyo eyilwe yiKorea Electric Power Corporation (KEPCO) ngo-2002. Uyilo lusekelwe kumava aqokelelwe ngophuhliso, ulwakhiwo, kunye nokusebenza kwe-OPR1000, i-Optimum Power Reactor 1000 MWe, isityalo sokuqala esisemgangathweni se-reactor yamanzi exinzelelo eKorea kwaye ikwabandakanya iimpawu ezivela kuyilo lwe-US Combustion Engineering (C-E) System 80+. I-APR1400 ineempawu ezininzi eziphambili ezifana nokufakwa kwesitya ngqo kwinkqubo yokufaka ukhuseleko, isixhobo sokulawula ukuhamba kwamanzi kwi-tank yokufaka ukhuseleko, inkqubo yokubonelela ngamanzi angaphakathi, inkqubo yokunciphisa uxinzelelo lokhuseleko oluphucukileyo, kunye neenkqubo zokunciphisa nokulawula iingozi ezinzima. Olunye uphuculo loyilo yigumbi lolawulo eliphambili eliphambili, eliyilwe ngokuqwalaselwa kobunjini bezinto zabantu, kunye neenkqubo ze-I&C zedijithali epheleleyo [45].

Okwangoku eMzantsi Korea kukho iiyunithi ezine ezisebenzayo (iiyunithi zeShin Kori 3 kunye ne-4, iiyunithi zeShin Hanul 1 kunye ne-2), kunye neeyunithi ezimbini ezisakhiwayo (iiyunithi zeShin Kori 5 kunye ne-6). Iiyunithi ezine zigqityiwe kwaye zisebenza kwezorhwebo kwi-United Arab Emirates eBarakah [45].

4.2.3 Hualong One HPR1000

I-Hualong One Nuclear Power Plant (NPP) yi-PWR yesizukulwana sesithathu eyaphuhliswa ngokudibeneyo yi-China General Nuclear Power Group (CGN) kunye ne-China National Nuclear Corporation (CNNC). Uyilo lusekelwe kubuchwepheshe obuqinisekisiweyo obuvela kuyilo lwe-CPR1000. I-CPR1000 yayiyi-reactor yesizukulwana sesibini eyaphuhliswa kubuchwepheshe obuvela kwi-Framatome (AREVA). Umbane we-HPR1000 yi-1100-1200 MWe kwaye isekethe yayo ephambili yenziwe ngee-loops ezi-3.

I-HPR1000 ibonakaliswa ngumgangatho ophezulu wokhuseleko osekwe kwiinkqubo zokhuseleko ezisebenzayo nezingasebenziyo, amanyathelo okuthintela iingozi ezinzima kunye nokunciphisa, ukhuseleko oluphuculweyo kwiziganeko zangaphandle kunye nokukwazi ukuphendula ngokukhawuleza. Le teknoloji iqulethe izinto ezintsha zobuchwepheshe, kubandakanya uyilo oluphambili lwe-reactor core kunye nokugcinwa kwegobolondo eliphindwe kabini. Ubuninzi bomonakalo ophakathi kunye nobukhulu bokukhululwa kuthiwa bungcono kakhulu kuneemfuno zokusetyenziswa kwezobuchwepheshe besizukulwana sesithathu eMelika naseYurophu. Ukongeza, le teknoloji inokumelana okuphezulu kwenyikima kwaye iyakwazi ukumelana nempembelelo yokuwa kweenqwelo-moya ezinkulu zorhwebo.

Okwangoku iiyunithi ezi-6 ze-HPR1000 zisebenza eTshayina, oko kukuthi iYunithi yesi-5 neyesi-6 yeFuqing Nuclear Power Plant, iYunithi yesi-3 yeFangchenggang, iiYunithi zesi-3 neyesi-4 zeChangjiang, kunye neYunithi yesi-1 yeZhangzhou. Ezinye iiyunithi ezimbini zafakwa kurhwebo ePakistan, oko kukuthi iiYunithi zaseKarachi K2 kunye neK3. Ezi yunithi zibonakalise ukusebenza kakuhle. Ezinye iiyunithi ziyakhiwa kwaye/okanye zicwangcisiwe [46].

4.2.4 European Pressurised Reactor (EPR)

I-EPR yi-PWR eyilwe yiFratome kunye ne-EDF (eFransi) kunye neSiemens (eJamani) kunye neyunithi yokuqala ye-EPR esebenzayo eyaqaliswa eTshayina (eTaishan 1) ngo-2018. I-Taishan 2 yaqala ukusebenza kwezorhwebo ngoSeptemba 2019. Iyunithi yokuqala ye-EPR ukuqala ukwakha, e-Olkiluoto eFinland, yaqala ukusebenza kwezorhwebo ngo-2023. Iyunithi yesibini ye-EPR ukuqala ukwakha eFlamanville eFransi yaqala ukusebenza kwezorhwebo ngo-2024.

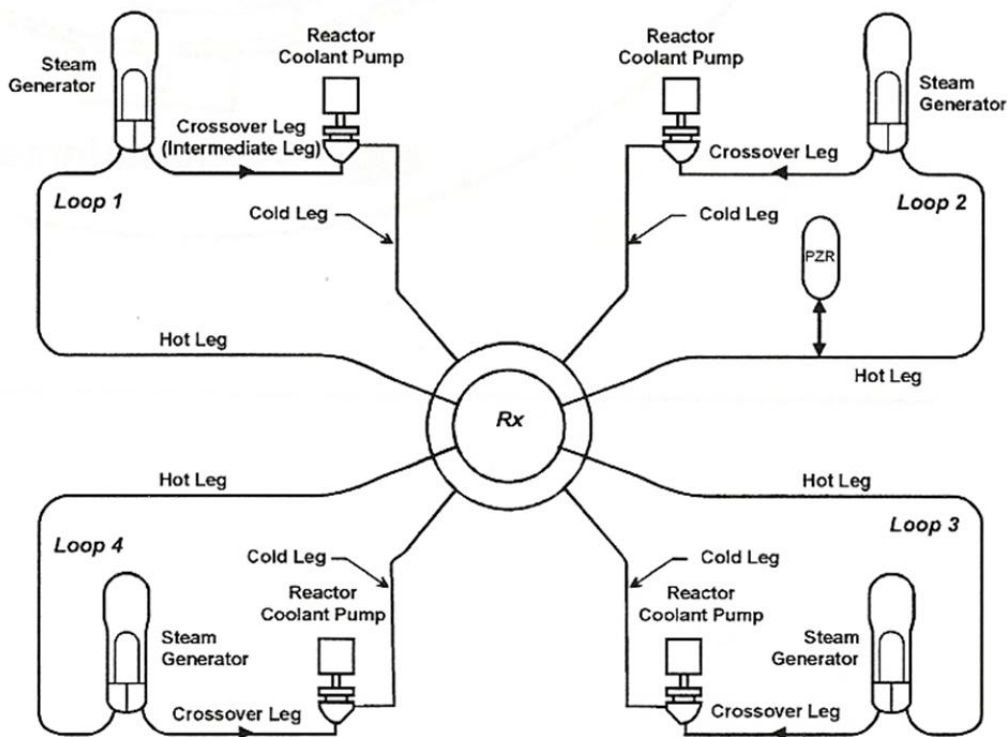
Sisityalo esineeluphu ezine. Iluphu nganye yenziwe yijenereyitha yomphunga kunye nepompo yokupholisa i-reactor, zonke ziqhagamshelwe kwi-reactor. Inkqubo yonke ephambili inoxinzelelo olunye kuphela oluqhagamshelwe kumlenze oshushu we-reactor njengoko kubonisiwe kuMfanekiso 3.

Uyilo lokhuseleko lwe-EPR lusekelwe ikakhulu kuhlalutyo oluqinisekileyo oluncediswa luhlalutyo olunokwenzeka. Indlela yokuqinisekisa isekelwe kwingcamango enzulu yokuzikhusela, equka amanqanaba amane, iinjongo zawo zezi:

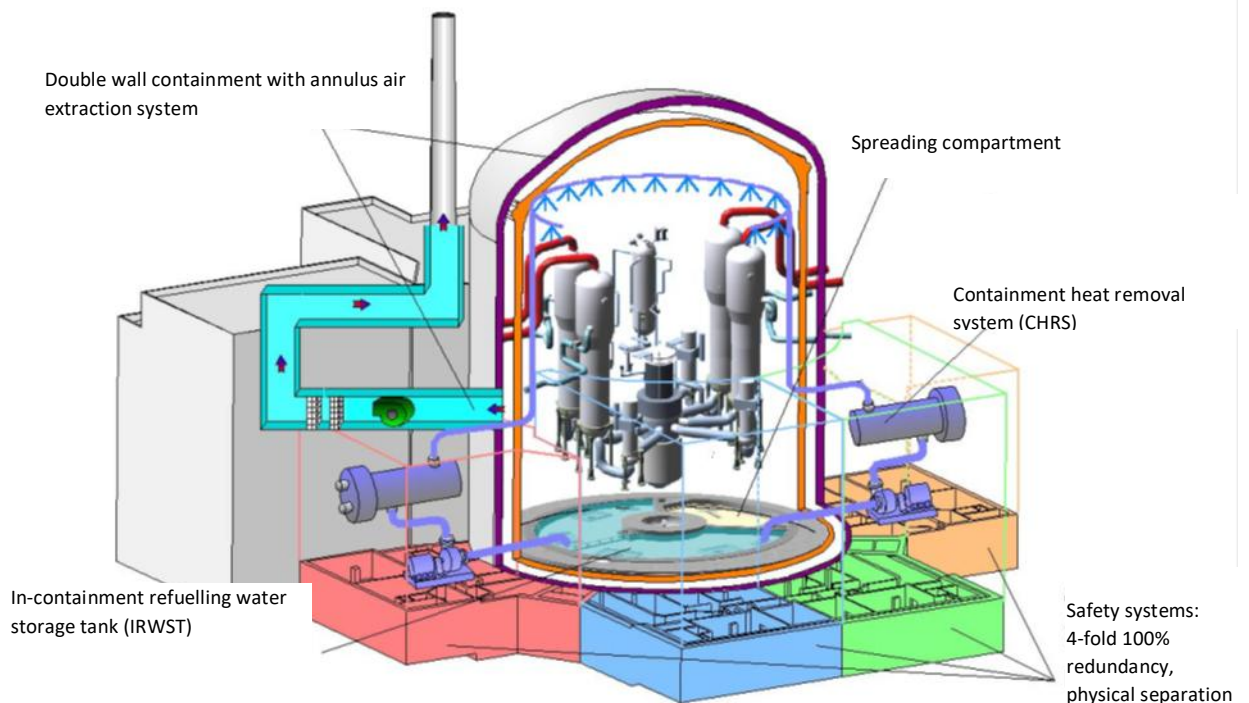
- Ukulungisa ukusilela kwabantu kunye namacandelo abo;
- Ukugcina ukusebenza kakuhle kwezithintelo ngokuthintela umonakalo kwisityalo nakwizithintelo ngokwazo;
- Ukukhusela uluntu kunye nokusingqongileyo kwingozi xa ezi zithintelo zingasebenzi ngokupheleleyo.

Ngokusekelwe koku, eyona nto iphambili kumgaqo onzulu wokuzikhusela kukuthintela iingozi, kwaye ukuba oku kuyasilela, ukunciphisa iziphumo ezinokubakho kunye nokuthintela naluphi na utshintsho oluya kwimeko embi ngakumbi. Isebenzisa iinkqubo zokhuseleko ezisebenzayo (ezifana namandla ombane atshintshanayo) ukukhusela isityalo.

Inxalenye enkulu yokukhululwa kwezinto ezinemisebe ezikhutshwa kwindalo esingqongileyo kwisiganeko somonakalo oyintloko iya kuba ngaphantsi kwesinye kwisigidi ngonyaka kwi-reactor enye. Ezinye zezona mpawu zibalulekileyo zokhuseleko ze-EPR njengoko ziboniswe kuMfanekiso 4 [47]



Umfanekiso 3: Umzekeliso wolungelelwaniso oluqhelekileyo lwee-SSC kwisityalo senyukliya esinezijikelezo ezine



Umfanekiso 4: Iimpawu eziphambili zokhuseleko lwe-EPR PR

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4.2.5 VVER1200

I-VVER-1200 (AES-2006) luyilo lwesixhobo sophehlo lwamandla eNyukliya lwase-Russia olumiselwe umgangatho, olwanelisa iimpawu zoyilo lwe-Generation III+ yaye luzama ukufikelela kukhuseleko lwangoku neempawu zokuthembeka, lulungiselela iindleko zokwakha. U- VVER umele ukuba yeya 'sisixhobo samandla samanzi-kumanzi' (oko kukuthi isixhobo sombane esipholiswa ngamanzi nesamandla athothiswa ngamanzi). Ii-VVER zifakwa kakhulu e-Russia kodwa nase-China, Finland, Germany, Slovakia, Bulgaria, India kunye nase-Iran.

Ezona mpawu yahluka ngazo i-VVER xa ithelekiswa kwezinye ii-PWR:

- Izivelisi zomophu ezibutyaba-
- Iindawo ezidibanisa amafutha ezinamacala amathandathu
- Akukho ngenelo luvela ngasezantsi kwisikhongozeli soxinzelelo
- Izifaki xinzelelo ezinamandla kakhulu ezinika indawo enkulu yesixhobo sokupholisa.

I-VVER idibanisa ukuthembeka kwezisombululo zobunjineli ezisele zivavanyiwe ngokuhamba kwexesha kunye neseti yeenkqubo zokhuseleko ezisebenzayo nezizenzekelayo ezihambelana neemfuno ezamisela emva kwengozi yaseFukushima.

Ichibi lokugcina amafutha enyukliya asetyenzisiweyo elingaphakathi kwendawo yokhuseleko, izihluzi zokungenisa umoya ezikwisithuba phakathi kweendawo zokhuseleko, isixhobo sokubamba intliziyo yereyitha xa inyibilika esinomaleko okhethekileyo wekhronkrithi, inkqubo engenakuthelekiswa nanto yokususa ubushushu ngokwendalo, kunye nobunye ubuchwepheshe bale mihla obufakwe kuyilo lwe-VVER-1200, ngokungathandabuzekiyo buyenza ibe yireyitha yesiZukulwana III+. Inkqubo yokupholisa intliziyo yereyitha ngexesha likaxakeka nayo ibandakanya ubuchwepheshe obuphambili. Enye yezi ndlela kukugcinwa kwe-asidi ye-boric ebandayo iphantsi koxinzelelo kwiitanki ezikhethekileyo. Kwimeko yokophuka kwendawo yokhuseleko okanye kwemibhobho, iivalvu ziyavuleka aze loo asidi ye-boric ifakwe kwintliziyo yereyitha ukuze kumiswe ukusabela kwechain reaction nokupholiswe ireyitha. Inkqubo yokupholisa intliziyo yereyitha ngexesha likaxakeka, xa idityaniswe nezinye iinkqubo zokhuseleko, iqinisekisa umgangatho ophezulu kakhulu wokhuseleko lwereyitha [48].

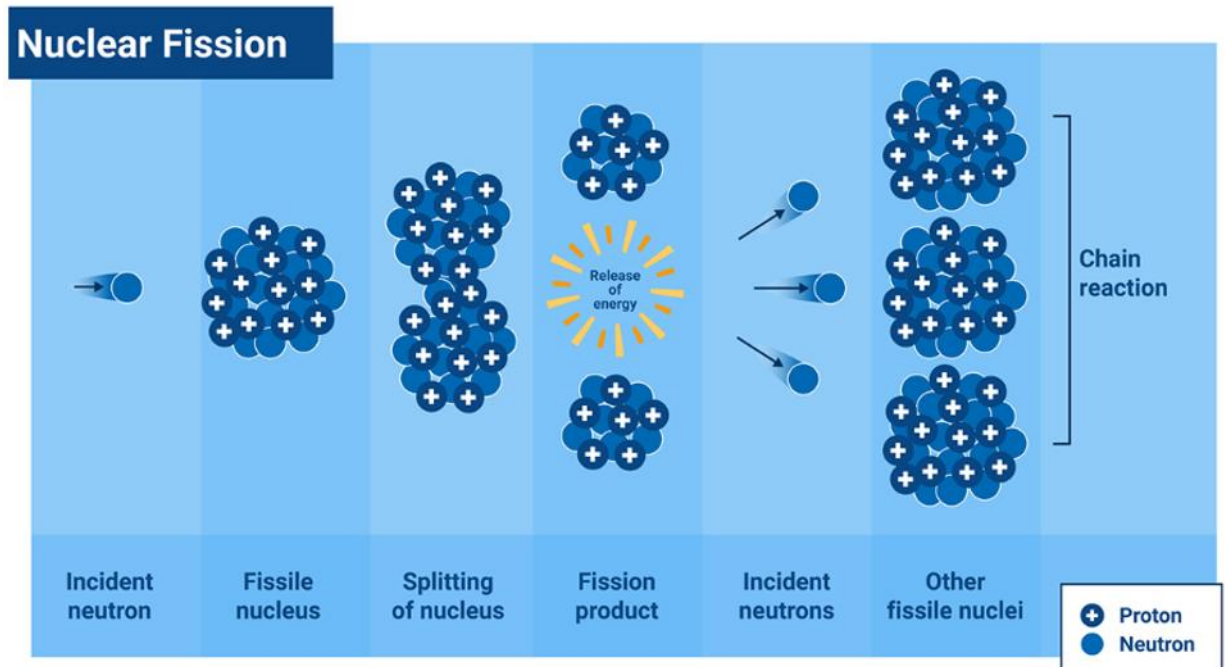
4.3 Ukuphehlwa Kombane Kwiindawo Zophehlo Lwamandla Enyukliya

4.3.1 Ukudityaniswa Kwee-Athom Zenyukliya.

Amandla enyukliya axhomekeke kwi-uranium etyebileyo ephantsi kunye/okanye i-mixed oxide (MOX) njengomthombo wamafutha ukuvelisa ubushushu. Ubushushu obuveliswa ngexesha leempendulo zenyukliya buvela kwinkqubo ebizwa ngokuba yi-'fission'. Ukuqhekeka kubandakanya ukuqhekeka kweenuclei zeeathomu ngamasuntswana amancinci, abizwa ngokuba zii-neutron. Xa i-nucleus enkulu ye-athomu efisileyo ibethwa yi-neutron, iyaqhekeka ibe ziinuclei ezimbini okanye ngaphezulu ezincinci njengeemveliso zokuqhekeka kwaye

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ikhuphe amandla kunye nee-neutron kwinkqubo. Emva koko ii-neutron ezikhululekileyo zibangela ukuqhekeka okungakumbi, kwaye inkqubo yokuqhekeka iyaqhubeka kwi-chain reaction. Ukuqhekeka kweeathomu kunye nokukhululwa kwamandla okulandelayo kubizwa ngokuba yi- inyukliya ukuqhekeka (Umfanekiso 5).



Umfanekiso 5: Impendulo yokuqhekeka kwenyukliya [43]

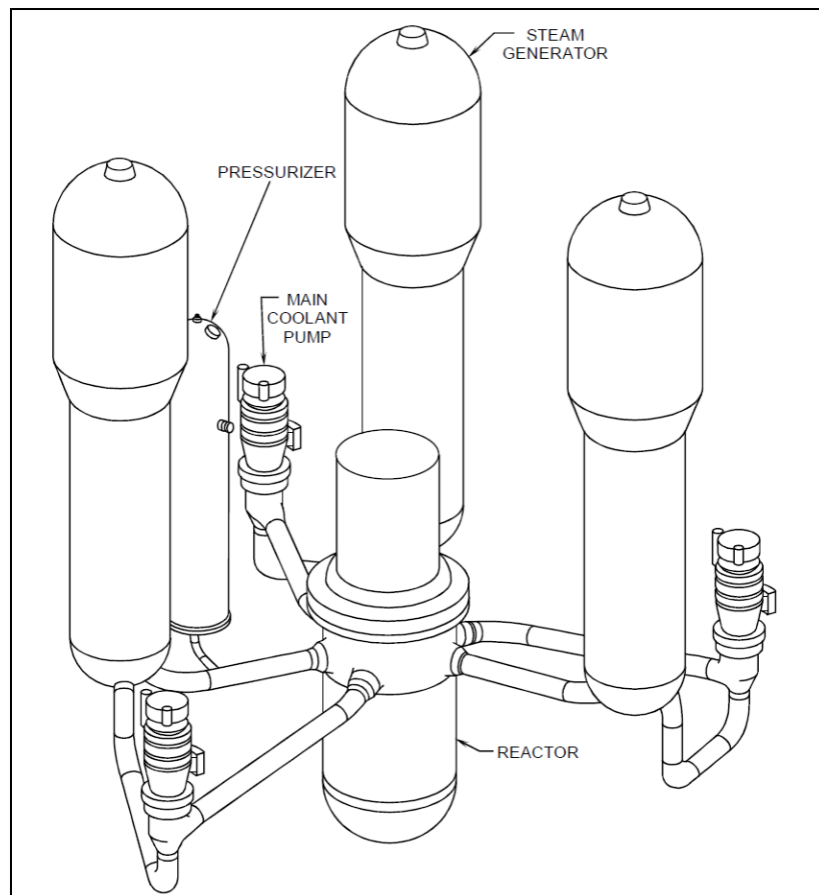
Inkqubo yokuqhekeka ilawulwa ngononophelo ngokusebenzisa i-boric acid enyibilikisiweyo kwinkqubo yokuqala (i-reactor coolant) amanzi kunye neentonga zokulawula i-reactor ukuqinisekisa ukuba imida yoyilo ayidluli. Amanzi enkqubo yokuqala ajikeleziswa kwinkqubo yokuqala ukususa amandla obushushu kwi-reactor ngomlenze oshushu we-reactor aze angene kwi-steam generator. Kwi-steam generator, amanzi esekethe yokuqala ayapholiswa njengoko edlulisela ubushushu bawo kwisekethe yesibini. Ukusuka kwi-steam generator, amanzi esekethe yokuqala emva koko ampontshwa abuyele kwi-reactor core ngomlenze obandayo we-reactor ziipompo ze-reactor coolant, apho aphinde afudunyezwe ngamandla akhutshwa kwinkqubo ye-nuclear fission. Uninzi lwee-reactor zamanzi ezixinzelelweyo zine-loops ezintathu zisekethe eziphambili, oko kukuthi, ii-generator ezintathu zomphunga kunye neepompo ezintathu eziphambili. Enye ye-loops zisekethe eziphambili ine-pressuriser egcina uxinzelelo lwenkqubo yokuqala luphezulu ngokwaneleyo ukuthintela amanzi kwisekethe yokuqala ukuba abile, yiyo loo nto ibizwa ngokuba yi-pressurised water reactor (Umfanekiso 6)

Kwinkqubo, ubushushu budluliselwa phakathi kwe-primary kunye neenkqubo ze-secondary. Kwicala lesibini lejenereyitha yomphunga, amanzi ayavunyelwa ukuba abilise ukuze aguqulwe abe ngumphunga. Lo mphunga usetyenziselwa ukuqhuba i-turbine, eqhuba ijenerereyitha evelisa umbane. Emva kokudlula kwi-turbine, umphunga ufakwa emanzini kwi-condenser ukuze uphonswe ubuyele kwijenereyitha zomphunga, ugqibezele isekethe yesibini. Kwimeko

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yaseKoeberg, nanjengoko kuya kuba njalo kwiThyspunt, amanzi olwandle ampontshwa nge-condenser kwisekethe yesithathu, okanye yesithathu, yamanzi, kwaye ubushushu obuseleyo obukhutshwa kumphunga kwi-condenser budluliselwa elwandle.

Itekhnoloji ye-PWR ngokubanzi isebenza ngokusebenzisa iisekethe ezintathu zamanzi ezahlukeneyo: eyokuqala, eyesibini, kunye neyesithathu. Injongo yokwahlula ezi nkqubo zintathu kukuqinisekisa ukuba amanzi kwinkqubo ephambili, ene-radioactive kwaye kwinkqubo evaliweyo, ahlukaniswe ngokupheleleyo kwinkqubo yesithathu yinkqubo yesibini, ethintela naluphi na unxibelelwano phakathi kwenkqubo yokuqala kunye nenkqubo yesithathu, njengoko inkqubo yesithathu ivulelekile kwindalo esingqongileyo.



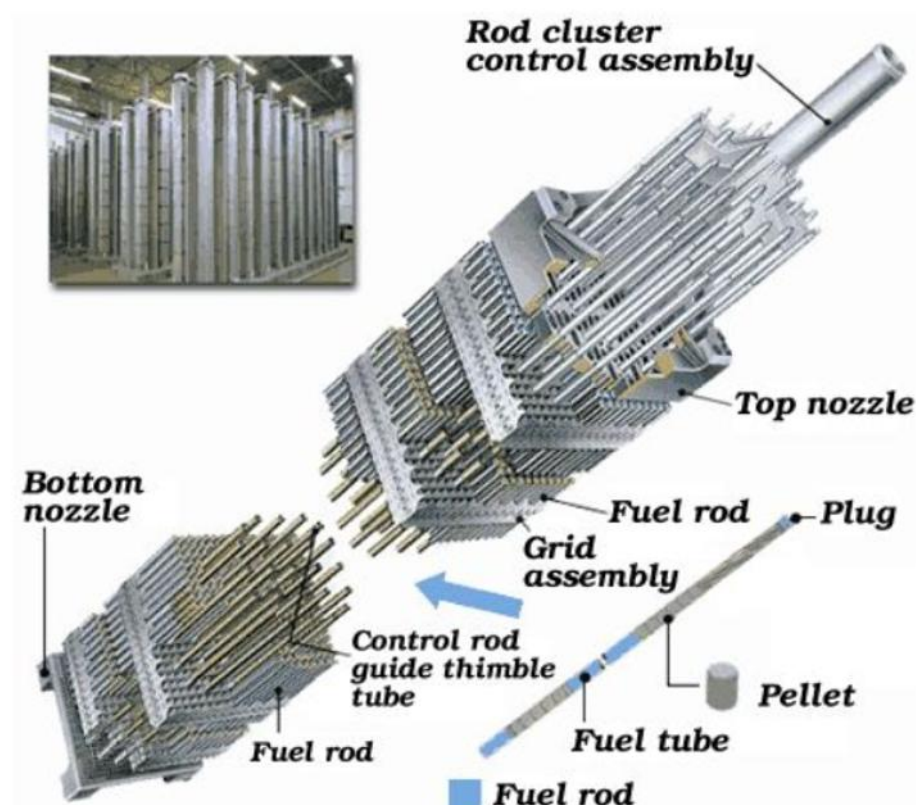
Umfanekiso 6: Umzekeliso wolungelelwaniso oluqhelekileyo lwee-SSC kwisityalo senyukliya esinezijikelezo ezintathu

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4.3.2 Izinto ezisebenzisa i-radioactive ezisetyenzisiweyo

I-reactor yenyukliya ivelisa kwaye ilawula ukukhululwa kwamandla ngenkqubo yokughekeka (oko kukuthi, ukwahlukana kweeathom) isebenzisa ikakhulu ii-isotopes ze-uranium-235 ($U-235$) ngendlela yee-pellets ze-uranium dioxide (UO_2), njenge-fuel. Ii-pellets ze- UO_2 zibekwe kwiityhubhu ukwenza iintonga ze-fuel, ezifakwa kwi-core ye-reactor njengeendibano ze-fuel, eziboniswe kuUmfanekiso 7. Kwi-core ye-reactor ii-isotope fissions ze- $U-235$ ziyaqhekeka, zivelisa ubushushu kwinkqubo eqhubekayo ebizwa ngokuba yi-chain reaction.

Amanzi asetyenziswa njenge-moderator yokucuthisa ii-neutrons ezikhutshwa kwinkqubo yokughekeka ukuze zibangele ukuqhekeka okungakumbi, ngelixa iintonga zokulawula kunye ne-boron enyibilikisiweyo kwi-coolant ephambili zisetyenziselwa ukufunxa ii-neutrons ukulawula izinga lokusabela ngaphakathi kwi-core ye-reactor.



Umfanekiso 7: Umzobo wendibano yepetroli ye-PWR eqhelekileyo, kunye nentonga yepetroli, intonga yokulawula kunye nezinto zepellet yepetroli eziboniswe ngokwahlukeneyo. (faka: ifoto yepellet yepetroli engakhanyiswang [49])

Uhlobo lwee-reactor zenyukliya ezinokuthi zibekwe kwindawo yaseThyspunt zenzelwe ukugcina ukusabela okuqhubekayo kwe-uranium etyebileyo, equlethwe kwiindibano zepetroli zenyukliya ezenzelwe ngokukodwa.

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Njengomzekelo, iindibano zepetroli ze-AP1000 ziyafana nezinye iindibano zepetroli ze-PWR ezifana neendibano zepetroli ze-17x17 eziqinileyo kunye ne-17x17 XL eziqinileyo, apho kukho amava amakhulu okusebenza. Iindibano zepetroli ze-17x17 eziqinileyo zinobude obusebenzayo obumalunga ne-3.7 m kunye neegradi ezintathu zokuxuba eziphakathi kwi-gradi ye-vane yokuxuba ephezulu. Iindibano zepetroli ze-17x17 XL eziqinileyo zinobude obusebenzayo bepetroli obumalunga ne-4,3 m ngaphandle kweegradi zokuxuba ezihamba ngokukhawuleza. Iindibano zepetroli ze-AP1000 ziyafana neendibano zepetroli ze-17x17 XL eziqinileyo kwaye ziqulathe iintonga zepetroli ze-264 kwi-array yesikwere ye-17x17. Iinduku zepetroli zenziwe nge-uranium, enongiweyo ukuya kuthi ga kwi-5 wt% U-235, ngendlela yeepellets ze-uranium dioxide ezisilinda, ezikwiityhubhu ze-ZIRLO™. Iityhubhu zivaliwe kwaye zitywinwe zitywinwe eziphelweni ukuze zigqume ipetroli. Iinduku zepetroli zixinzelelwa ngaphakathi nge-helium ngexesha lokwenziwa ukunciphisa ukuqhekeka kwe-clad ngexesha lokusebenza kwaye ngaloo ndlela zithintele ukucaba kwe-clad. Iinduku zepetroli kwi-AP1000 fuel assemblies zinendawo eyongezelelweyo yegesi ngaphantsi kweepellets zepetroli, xa kuthelekiswa noyilo lwangaphambili lwe-fuel assemblies, ukuvumela ukwanda kwemveliso yegesi yokughekeka ngenxa yokutsha okuphezulu kwepetroli. Iinduku zepetroli zinokuba nezifunxi ezitshayo ngendlela yeepellets zepetroli ezine-boride-coated okanye iipellets zepetroli ze-uranium oxide ezixutywe ne-gadolinium oxide, okanye indibaniselwano, yokulawula ukusabela kumbindi.

Indawo ephakathi kwindibano yamafutha ye-AP1000 ine-thimble ekhokelayo egcinelwe izixhobo ezingaphakathi. Ezinye iindawo ezingama-24 kwindibano yamafutha zine-thimbles ezikhokelayo, ezidityaniswe neempumlo eziphezulu nezisezantsi zendibano yamafutha ukuze zibonelele ngesakhiwo esixhasayo seegradi zamafutha. Iindibano zamafutha ze-AP1000 zine-grids ezintathu eziphakathi zokuxubana kwi-gradi ephezulu ye-vane yokuxubana.

Iimpawu ezininzi zoyilo eziqinisekisiweyo zifakiwe kuyilo lwendibano yamafutha ye-AP1000, njengeegradi eziphakathi zoxinzelelo oluphantsi, iigradi zokuxubana ezihamba phakathi, i-nozzle edibeneyo ye-Westinghouse ephinda ilungiswe, kunye nokukwazi ukutsha okwandisiweyo. I-nozzle esezantsi yi-nozzle esezantsi yesihluzi senkunkuma enciphisa amathuba omonakalo wepetroli ngenxa yenkunkuma kwi-reactor coolant. Uyilo lwendibano yamafutha ye-AP1000 lukwabandakanya igradi ekhuselayo yokumelana nokungcola okwandisiweyo.

I-core ye-EPR inokwamkela uyilo olwahlukeneyo lwendibano yamafutha olufana nohlobo lwe-AFA 3GL okanye i-HTP. Indibano yamafutha e-EPR inobude obusebenzayo obumalunga ne-4,2 m kwaye ineentonga zamafutha ezingama-265 ezicwangcisiwe kwi-matrix eyi-17 × 17. Indibano ikwanazo nee-24 guide thimbles ezisetyenziswa njengeendawo zeendibano zolawulo lweentonga (ii-RCCA) kunye nezixhobo ezishukumayo ezingaphakathi kwe-core.

Iintonga zendibano yamafutha e-EPR zenziwe ngeetyhubhu ze-M5TM alloy ezimelana nokugqwala kakhulu nezikhula kancinci. Ezi ntonga ziqulathe ii-UO2 ceramic pellets, ezinokwandiswa kokuqala okungaphantsi okanye okulingana ne-5 wt% U-235. Iintonga zamafutha zithintelwe ngoomatshini ngokwe-axial kunye ne-radially kwisakhiwo sendibano

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yamafutha ngee-grids ezisibhozo ze-M5TM eziphakathi kunye nee-grids ezimbini ze-end spacer. Ii-pellets ziqulathe i-Gd₂O₃ njenjetyhefu evuthayo apho uxinaniso lwe-Gd lungahluka phakathi kwe-2 wt% kunye ne-8 wt% ukuze kuthintelwe ukusabela okuphezulu okugqithisileyo kwi-core. Ngokuxhomekeke kubungakanani betyhefu etshayo efunekayo ukuhlangabezana neemfuno zoyilo okanye zokhuseleko, inani leentonga ze-Gd₂O₃ kwindibano yamafutha linokwahluka ukusuka kwi-8 ukuya kwi-20.

wizakhiwo zamafutha ekuxoxwe ngazo apha, uxinzelelo (okanye ubuninzi) lweemveliso zefission kunye nezinto ezinzima luya ukwanda ngexesha lokusebenza, ukuya kuthi ga kwinqanaba apho kungasakwazi ukuqhubeka nokusebenzisa ipetroli. Xa isusiwe kwi-reactor, ipetroli esetyenzisiweyo iya kuqhubeka nokukhupha imitha kunye nobushushu. Imijikelo yokuvala ipetroli idla ngokuba phakathi kweenyanga ezili-12 nezingama-24. Ngexesha lokuvala ipetroli, isithathu seendibano zepetroli siyatshintshwa, oko kukuthi, isibini kwisithathu seendibano zepetroli esetyenzisiweyo ziyalayishwa kwakhona kunye nesithathu kwisithathu seendibano zepetroli ezintsha (ezintsha).

Ukusuka kwisiseko se-reactor, iindibano zepetroli esetyenzisiweyo zifakwa kwidama lepetroli esetyenzisiweyo ukuvumela ubushushu kunye nemitha ukuba yehle ukuya kumanqanaba amkelekileyo ngaphambi kokuba idluliselwe kwiibhokisi zokugcina ipetroli esetyenzisiweyo eyomileyo. Kwidama lepetroli esetyenzisiweyo, amanzi abonelela ngokukhusela kwimitha kwaye afunxe ubushushu obukhutshwa yipetroli. Iindibano zepetroli esetyenzisiweyo zigcinwa kwiidima zepetroli esetyenzisiweyo ubuncinane iminyaka eli-10 ukuvumela ukupholisa ukuze ipetroli esetyenzisiweyo ibe namandla aphantsi kakhulu ashiyekileyo xa idluliselwa kwiibhokisi zokugcina ipetroli eyomileyo.

4.4 Imitha Kunye Ne-Radioactivity

4.4.1 Ukukhanya Kwemitha Kubomi Bemihla Ngemihla

Esi sicatshulwa silandelayo sithathwe kwiphepha le-IAEA malunga nemitha [56]:

Izinto ezisebenzisa imitha zendalo zikhona kuqweqwe lomhlaba, phantsi nakwiindonga zamakhaya ethu, izikolo, neeofisi, kwaye ekutyeni, siyatya size sisele. Kukho iigesu ezisebenzisa imitha zendalo emoyeni esiwuphefumlayo. Imizimba yethu - izihlunu, amathambo, kunye nezicubu - ziqulathe izinto ezisebenzisa imitha zendalo.

Sikwafumana ukuvezwa kwimitha eyenziwe ngumntu (njenge-X-ray), imitha esetyenziselwa ukuxilonga izifo kunye nonyango lomhlaza. Ukuphuma kovavanyo lweziqhushumbisi zenyukliya, kunye nobuninzi obuncinci bezinto ezisebenzisa imitha zenyukliya ezikhutshwa kwindalo evela kwizityalo zamandla amalahle kunye nenyukliya, nazo ziyimithombo yokuvezwa kwimitha zenyukliya ebantwini.

I-Radioactivity ligama elisetyenziselwa ukuchaza ukutshatyalaliswa kweeathom. I-athomu inokubonakaliswa linani leeprotoni kwinnucleus. Ezinye izinto zendalo azizinzanga. Ke ngoko, iinuclei zazo ziyaqhekeka okanye zibole, ngaloo ndlela zikhupha amandla ngendlela yemitha. Le nto ibonakalayo ibizwa ngokuba yi-radioactivity. Ukubola kwemitha zendalo kubonakaliswa

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kwiinyunithi ezibizwa ngokuba yi-becquerels. I-becquerel enye ilingana nokuqhekeka okukodwa ngomzuzwana.

Ixesha elithathwayo ukuba isiqingatha see-radionuclides siqhekeke okanye sibole libizwa ngokuba yi-half-life. Oku kwahluka kwi-radioelement nganye, ukusuka kwiinxalenye zesekhondi ukuya kwiibhiliyoni zeminyaka. Umzekelo, isiqingatha sobomi be-iodine-131 ziintsuku ezisibhozo, kodwa kwi-uranium-238, ekhoyo ngobuninzi obahlukeneyo kwiilabathi liphela, yi-4.5 yeebhiliyoni zeminyaka. I-Potassium-40, umthombo ophambili we-radioactivity emizimbeni yethu, inobomi obuyi-1.42 yeebhiliyoni zeminyaka.

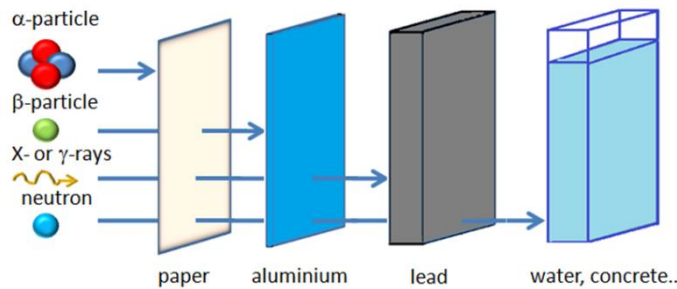
Igama elithi "i-radiation" libanzi kakhulu kwaye liquka izinto ezifana namaza okukhanya kunye nerediyo (ekwabizwa ngokuba yi-non-ionizing radiation). Kwimeko yokhuseleko lwenyukliya, oku kubhekisa kwi-ionizing radiation, oko kuthetha ukuba ngenxa yokuba loo mitha idlula kwizinto, inokutshajwa ngombane okanye i-ionised. Kwizicubu eziphilayo, ii-ion zombane eziveliswa yimitha zinokuchaphazela iinkqubo eziqhelekileyo zebhayoloji.

Imitha eqhelekileyo ye-ionizing ekuthethwa ngayo ngokubanzi yile ilandelayo:

- **Imitha ye-Alpha (α) iqulathe** amasuntswana anzima, atshajiwayo kakuhle akhutshwa ziiathom zezinto ezifana ne-uranium kunye ne-radium. Imitha ye-Alpha inokunqandwa ngokupheleleyo liphepha okanye ngumaleko obhityileyo wolusu lwethu (i-epidermis). Nangona kunjalo, ukuba izinto ezikhupha i-alpha zithathwa emzimbeni ngokuphefumla, ukutya, okanye ukusela, zinokuveza izicubu zangaphakathi ngokuthe ngqo kwaye, ke ngoko, zinokubangela umonakalo webhayoloji.
- **Imitha ye-Beta (β) iqulathe ii-electron.** Zingena kakhulu kuneesuntswana ze-alpha kwaye zinokudlula kwiisentimitha ezili-1-2 zamanzi. Ngokubanzi, iphepha le-aluminium elinobukhulu obuziimilimitha ezimbalwa liya kuyimisa imitha ye-beta.
- **Imitha ye-Gamma (γ) yimitha ye-electromagnetic** efana ne-X-rays, ukukhanya, kunye namaza erediyo. Imitha ye-Gamma, kuxhomekeke kumandla ayo, inokudlula ngqo emzimbeni womntu, kodwa inokunqandwa ziindonga ezinkulu zekhonkrithi okanye i-lead.
- **Ii-Neutrons ngamasuntswana angatshajiswanga kwaye azivelisi i-ionization ngokuthe ngqo.** Nangona kunjalo, ukusebenzisana kwazo neethom zezinto kunokubangela i-alpha, i-beta, i-gamma, okanye i-X-rays ezithi emva koko zivelise i-ionization. Ii-neutrons ziyangena kwaye zinokumiswa kuphela ziingqimba ezinkulu zesamente, amanzi, okanye iparafini.

Ukunciphisa iziphumo eziyingozi zemitha, kusetyenziswa izixhobo ezahlukeneyo zokukhusela uluntu ekuchatshazelweni yimitha ngokungafanelekanga, kuxhomekeke kuhlobo lwemitha olufunekayo ukhuseleko njengoko kubonisiwe kuUmfanekiso 8, othathwe kwi [60]. Nangona

ubukho bemitha bungenakubonwa okanye buvakalelwe, bunokubonwa kwaye bulinganiswe ngobuninzi obuncinci ngezixhobo zokulinganisa imitha ezilula.



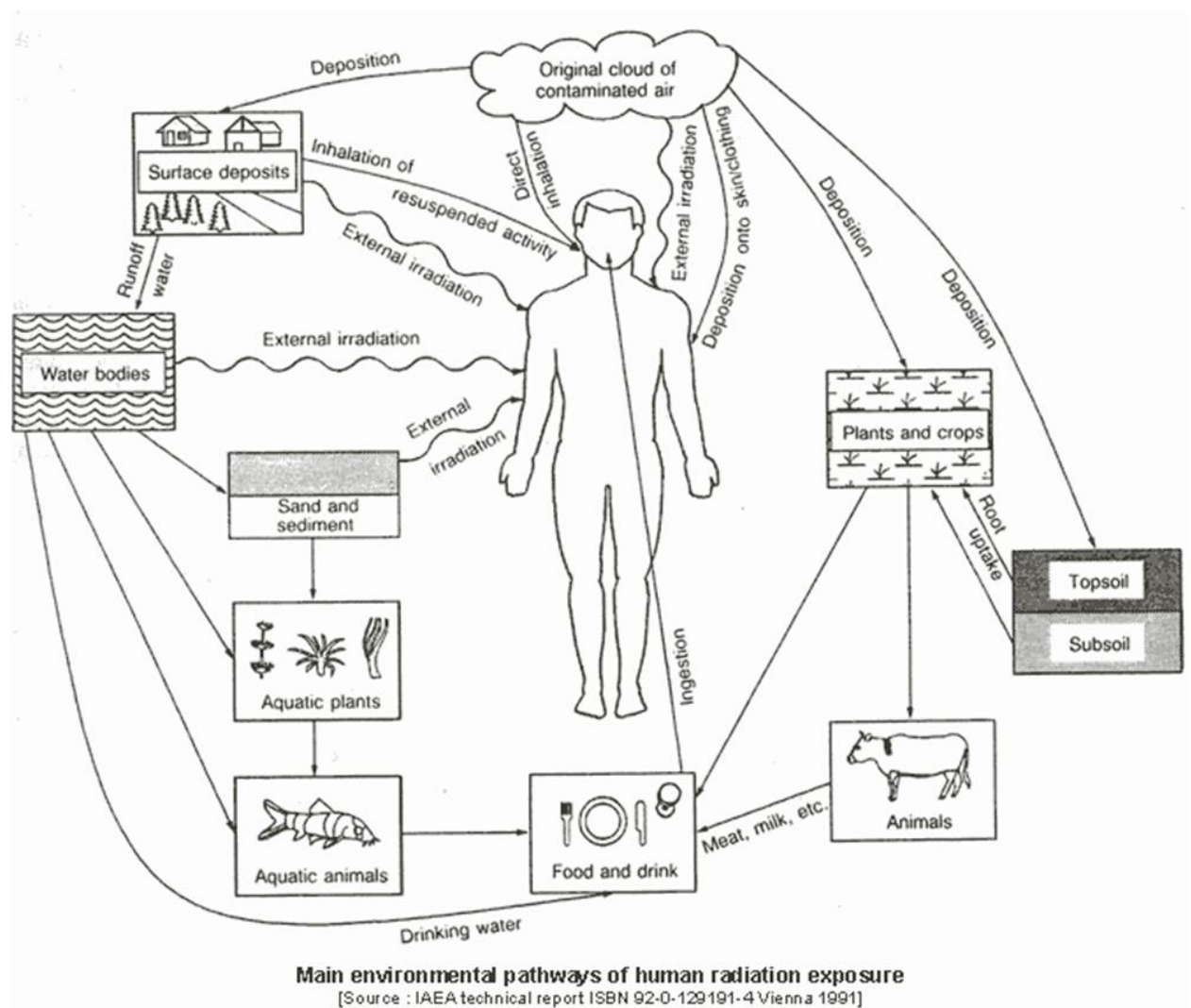
Umfanekiso 8: lindidi zemitha ye-ionizing kunye nezinto zayo zokukhusela

lingozi ezinxulumene nokuvezwa kwimitha zixhomekeke kuhlobo lwemitha, ixesha elihanjiswa ngalo, kunye nobungakanani bamandla afakwe kwizinto ezisetyenzisiweyo. Iziphumo ezibukhali zempilo ezifana nokutsha kwesikhumba, okanye i-acute radiation syndrome zinokwenzeka xa iidosi zemitha zidlula amanqanaba athile. Iidosi eziphantsi zemitha ezibangela i-ionizing zinokunyusa umngcipheko weziphumo zexesha elide ezifana nomhlaza. Iziphumo ezaziwayo ziquka umonakalo othe ngqo kwiiseli (i-DNA strand kwi-chromosome), ukuguqulwa kwe-chromosome, iingxaki zemfuza, iziphumo ezizuzwa njengelifa, ukungasebenzi kakuhle kwamalungu omzimba, umhlaza, kwaye kwezinye iimeko, ukufa.

4.4.2 Impembelelo yeRadiological kuLuntu

Ukuvezwa kungahlulwahlulwa ngokweendawo zomsebenzi (ukuvezwa kwabasebenzi ngenxa yomsebenzi wabo), ukuvezwa kwezonyango (ukuvezwa kwezigulane njengenxalenye yokuxilongwa okanye unyango lwabo), kunye nokuvezwa esidlangalaleni (ukuvezwa kwamalungu oluntu kwimitha ngenxa yokuvezwa kuzo zonke iintlobo zemithombo yemitha, eyenziwe ngumntu okanye yendalo).

Ukuvezwa kwimitha kunokuba ngaphakathi okanye ngaphandle, kwaye kunokufumaneka ngeendlela ezahlukeneyo zokuvezwa, umzekelo, ukuphefumla, ukuginya, okanye ngokuthe ngqo (jonga Umfanekiso 9). Ukuvezwa ngaphakathi kwenzeka xa i-radionuclide iphefumlwa, iginywa, okanye ifakwa inani elincinci lamasuntswana e-radioactive ngelixa ukuvezwa kwangaphandle kunokwenzeka xa umntu evezwa kwintsimi yemitha evela kumthombo wangaphandle umzekelo umntu emi ecaleni kwezixhobo okanye icandelo kwisikhululo samandla enyukliya esikhupha imitha ngexesha lokusebenza okuqhelekileyo.



Umfanekiso 9: lindlela zokuvezwa [59]

Umngcipheko wokuvezwa luluntu ngenxa yemitha ekhutshwa kwindalo esingqongileyo ulawulwa ngokusebenzisa inkqubo yokukhusela imitha (RP) kwisikhululo samandla enyukliya okanye kumashishini akhupha imitha. Le nkqubo inika umgangatho ofanelekileyo wokhuseleko kwimiphumo enokuba yingozi yemitha ye-ionizing kwi-biota yabantu kunye neyomntu (oko kukuthi, izilwanyana kunye nezityalo ezisetyenzisiweyo (i-RAPs)). Kubantu, le nkqubo isetyenziselwa ukuqinisekisa ukuba umngcipheko womhlaza kunye nemiphumo ezuzwayo incitshiswa ukuya kwinqanaba elinokwenzeka. Kwindalo esingqongileyo, le nkqubo isetyenziselwa ukuqinisekisa ukuba impembelelo kwindalo esingqongileyo ayinamsebenzi ukuze kugcinwe ulwahlulo lwezinto eziphilayo, ulondolozo lweentlobo, kunye nempilo kunye nesimo seendawo zokuhlala zendalo, uluntu, kunye ne-ecosystems.

Kwindlela yokuvezwa luluntu, idosi yemitha (idosi esebenzayo yonyaka) kuluntu iqikelelwa ngokubala isixa sedosi esebenzayo efunyenwe kwisithuba sonyaka omnye ukusuka ekubonakalisweni ngaphandle kunye nedosi esebenzayo evela kwi-radionuclides efakwe

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kwisithuba sonyaka. Oku kudityaniswe nedatha efunyenwe ekukhutshweni kwamanzi amdaka, imilinganiselo yendalo, kunye nedatha yemikhwa kunye nomzekelo.

Kwiimeko zokuvezwa okucwangcisiweyo, imida yedosi kunye nemida yedosi yendawo isetyenziswa njengendlela yokukhusela uluntu. Kwiimeko zongxamiseko kunye neemeko zokuvezwa ezikhoyo, umda onxulumene nomthombo kukusetyenziswa kwamanqanaba okubhekisa asetyenziselwa ukuphumeza amanyathelo okukhusela kwaye kwizilwanyana ezingezizo ezoluntu, ixabiso lokuhlola lisetyenziswa ukulinganisa umngcipheko wendalo.

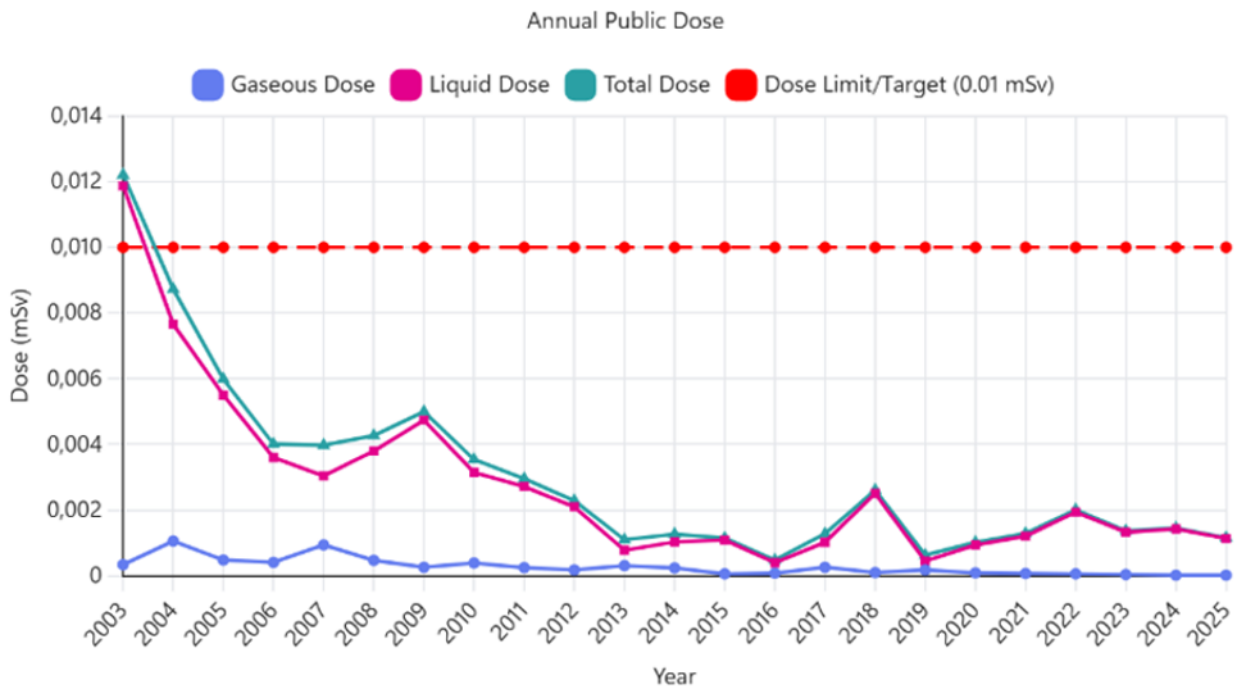
Kwiimeko zokuvezwa okucwangcisiweyo, kwiimeko zokuvezwa okucwangcisiweyo, umda wedosi we-1 millisievert ngonyaka uyasetyenziswa. I-NNR ichaza umda wedosi we-0.25 millisievert ngonyaka kumntu omeleyo (owayebizwa ngokuba lilungu eliqhelekileyo leqela elibalulekileyo) kwisenzo esigunyazisiweyo [4].

Kwimisebenzi nganye ecwangcisiweyo, kulindeleke ukuba umthamo kuluntu nakwindalo uhlolwe kuthathelwa ingqalelo zonke iindlela zokuvezwa. Umsebenzi owenziweyo ukuvavanya impembelelo yemitha kuluntu uqwalasela ukukhutshwa kolwelo kwindawo yolwandle, ukusasazwa kolwandle (ukungenwa kokutya emanzini, ukuphefumla i-sea spray), ukutsalwa kwenkunkuma (imitha yangaphandle), kunye nokukhutshwa emoyeni kuthathelwa ingqalelo ukusasazwa (imitha yangaphandle, ukuphefumla i-plume) kunye nokufakwa kwayo (imitha yangaphandle, ukumiswa, kunye nokutya komhlaba) njengoko kubonisiwe kuUmfanekiso 9.

Impembelelo yemitha kuluntu nakwindalo ikwavavanywa kwiimeko ezingxamisekileyo ukuze kuthathwe amanyathelo afanelekileyo okukhusela uluntu kunye nendalo.

Njengexalenye yemisebenzi yaso eqhelekileyo, isikhululo samandla enyukliya sikhupha ukungcola kolwelo kunye negesi kwindawo yokusingqongileyo phantsi kweemeko ezilawulwayo nezijongiweyo ukuqinisekisa ukuba umngcipheko kuluntu ugcinwa uphantsi kangangoko kunokwenzeka (ALARA) kwaye ngaphakathi kwemida yomthetho. Ukukhutshwa kolwelo kunye negesi kufuneka kuhambelane nemida ye-Annual Allowable Discharge Quantities (AADQs), ehambelana nomda wonyaka we-0.25 millisievert (okwaziwa ngokuba ngumda womthamo wendawo) kwilungu leqela elibalulekileyo kuluntu oluchatshazelweyo njengoko kuchaziwe yi-NNR ngokwemigaqo yoMthetho weSizwe weNyukliya no. 47 ka-1999 (NNRA) [36]]. Ngaphambi kokufumana ukufakelwa kwenyukliya okucetywayo kwindawo yaseThyspunt, kuya kwenziwa uvavanyo olongezelelweyo lokhuseleko ukubonisa ukufezekiswa okufanelekileyo kwemisebenzi yokhuseleko ngoyilo lokufakelwa kwenyukliya, kunye nokuqinisekisa ukuba imiqobo yokhuseleko eyenzelwe ukuqulatha izinto ezisasazwayo iya kuthintela naluphi na ukukhutshwa okungalawulwayo okunokuveza uluntu okanye okusingqongileyo phantsi kwazo zonke iimeko zokusebenza kwezityalo.

Umthamo woluntu ngenxa yokukhutshwa kokungcola okusasazwayo kwe-KNPS umzekelo, uboniswe kuUmfanekiso 10 wexesha eliphakathi kuka-2003 no-2024.



Umfanekiso 10: Ukuvezwa esidlangalaleni ngenxa yokusebenza kweKoeberg

Iziphumo zibonisa ukuba idosi yemitha iphantsi kakhulu kune-0.25 millisievert ngonyaka, idosi yendawo ethintela ukukhutshwa kwamanzi amdaka ane-radioactive. Kwiindawo ezintsha zenyukliya ezikwindawo yaseThyspunt, impembelelo yeradiyoloji enokubakho kuluntu nakwindalo esingqongileyo xa kujongwa amandla acwangcisiweyo angama-9 900 ukuya kwi-13 200 MWth kunye nomthamo wesiza esipheleleyo ukuya kuthi ga kumandla aphezulu angama-33 000 MWth wetekhnoloji ye-PWR GEN III yenziwe ngokusekelwe ekukhutshweni kwerediyo emoyeni naselulwelo ngexesha lokusebenza okuqhelekileyo. Uvavanyo lubandakanya iZinto eziSebenzayo eziLindelweyo (AOO) ezibizwa ngokuba zizinto ezincinci.

Ulwazi loyilo lweetekhnoloji ezine ezimele iGen III lusetyenzisiwe ukwakha imiqathango yemithombo yeradiyo yokukhutshwa kokusebenza kwindalo esingqongileyo. Imiqathango yemithombo edibeneyo ifunyenwe kwi-33 000 MWth yokusebenza kwamandla kunye nokwakheka kwerediyo kwindalo esingqongileyo emva kweminyaka engama-60 yokusebenza kwabandakanywa kuvavanyo lwedosi. Uvavanyo lwedosi lusekelwe kwiingcamango ezigcinayo ukubonisa ukuba iikhrayitheriya zolawulo zinokufezekiswa. Nje ukuba kukhethwe ufakelo oluthile lwenyukliya, inkcazo eneenkcukacha yazo zonke iinkqubo zofakelo

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Iwenyukliya kunye nolwakhiwo lwayo kwindawo iya kuboniswa kwaye idosi kawonkewonke ihlolwe kwakhona.

Idosi yonyaka kumntu wonke ibalwe kusetyenziswa idatha yamva nje yemikhwa yabantu abahlala nabasebenza kwiindawo ezikufutshane nendawo apho ukuvezwa ngemitha kunokwenzeka ngeendlela ezahlukeneyo zokuvezwa ezibandakanya ukusetyenziswa kokutya, imitha yangaphandle kunye nokuphefumla i-radioactivity ekhutshwa kwindawo (kwiindawo) ezicetywayo zenyukliya.

Idosi iyonke yonyaka yomntu ngamnye iqikelelwa ukuba yi-0.171 millisievert ngonyaka. Ngoko ke, kunokugqitywa kwelokuba ukufakelwa kwenyukliya entsha kwindawo enomthamo omkhulu wokuvelisa we-33 000 MWth kuya kuthobela umda wedosi kawonkewonke we-NNR kunye namaxabiso okuthintela idosi we-0.25 millisievert ngonyaka kunye nomda wedosi we-1 millisievert ngonyaka kwindawo.

Kuye kwenziwa uphando ukuze kuchongwe idosi kwi-biota engeyoyabantu. Iziphumo zovavanyo lokuhlolwa kwe-radio-ecological azibonisi mpembelelo ibalulekileyo ye-radiological kwizilwanyana ezingeyoyabantu. Akukho nanye kwezi zinto eziphilayo ezihlolwe kusetyenziswa ikhowudi ye-ERICA, egqithile ixabiso lokuhlolwa le-10 $\mu\text{Gy/h}$.

4.4.3 Ukuvezwa Emsebenzini Kwimitha

Abasebenzi abaqeshwayo ukuba basebenzele i-Eskom njengabasebenzi be-radiation bavavanywa kakhulu ukuze kuqinisekise ukuba bakulungele na ukusebenza kwindawo ene-radiation. Ngaphambi kokuba basebenze kwindawo ene-radiation, abasebenzi baqeqeshwa kwaye baqinisekise njengabasebenzi be-radiation. Oku kwenza ukuba umsebenzi afunde kwaye aqonde umngcipheko onxulumene nokuchatshazelwa ngamanqanaba aphezulu e-radioactivity kwaye aziswe ngamanyathelo akhoyo okubakhusela. Abasebenzi be-radiation banikwa i-electronic personal dosimeter (EPD) kunye ne-thermo-luminescent detector (TLD) eboniswe kUmfanekiso 11 kunye noUmfanekiso 12 ngokwahlukeneyo. Ezi zixhobo zinxitywa ukujonga amanqanaba abo okuvezwa yi-radiation (idosi ye-radiation) xa basebenza kwiindawo apho bachatshazelwa yi-radiation (ebizwa ngokuba ziindawo ezilawulwayo).



Umfanekiso 11: Idosimitha yomntu ngamnye ye-elektroniki (i-EPD) [61]



Umfanekiso 12: I-Thermo-luminescent dosimeter (TLD) [62]

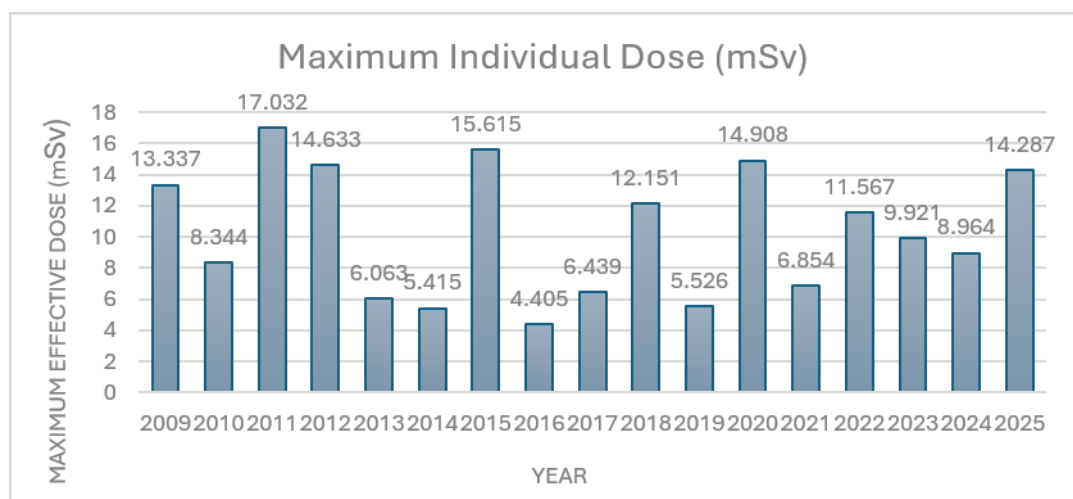
Abasebenzi bemisebe abenza umsebenzi kwindawo elawulwayo banikwa izixhobo zokuzikhusela zobuqu ezihambelana nokhuseleko olufunekayo kuloo nqanaba longcoliseko kunye ne-dosimetry yokulinganisa idosi yabo.

Ukunciphisa iziphumo eziyingozi zemisebe xa bephatha imithombo yemisebe, kusetyenziswa iinkalo "zexesha, umgama, kunye nokukhusela" ezixhasa umgaqo we-ALARA wokukhusela imisebe onokuchazwa ngolu hlobo lulandelayo:

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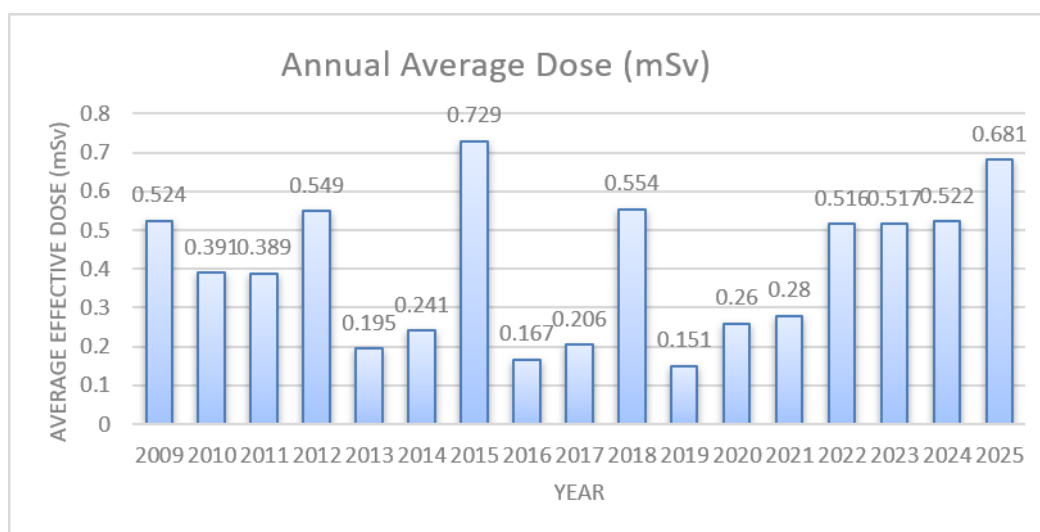
- Okukhona umntu echitha ixesha elide (ubude) kufutshane nomthombo wemisebe/izinto ezisebenzisa imisebe, kokukhona idosi iphezulu, kwaye ke ngoko, kokukhona iingozi zempilo zinkulu.
- Okukhona umgama umfutshane phakathi komthombo wemisebe nomntu owusebenzisayo, kokukhona amathuba eengozi zempilo aphezulu.
- Okukhona izinto zokukhusela ezisetyenziswayo kuhlobo oluthile lwemisebe, kokukhona ukhuseleko lungcono kwiziphumo eziyingozi zemisebe.

Xa umntu echaphazeleka emsebenzini kwiimeko ezicwangcisiweyo zokuchatshazelwa, umda ophezulu wedosi yomntu ngamnye yi-20 mSv ngonyaka ngokwe-avareji kwixesha leminyaka emihlanu (100 mSv kwiminyaka emi-5), kunye nelungiselelo lokuba idosi esebenzayo ayidluli kwi-50 mSv kuyo nayiphi na iminyaka. EKoeberg, ebisebenza malunga neminyaka engama-40, iidosi zabasebenzi zingaphakathi kwemida emiselweyo; umzekelo, idosi ephezulu yomntu ngamnye yayiyi-17 mSv ngo-2011 (umda we-50 mSv). Umfanekiso 13 ubonelela ngeedosi zabasebenzi eziphezulu ezifunyenweyo kwixesha lika-2009 ukuya ku-2025. Oku kubonisa ukuthambekela kokunciphisa (ukuphucula) kwixesha.



Umfanekiso 13: Idosi ephezulu yabasebenzi efunyenweyo ngonyaka eKoeberg

Umzekelo, injongo ye-ALARA ye-4 mSv imiselwe eKoeberg ngedosi ephakathi yabasebenzi. Injongo iphantsi kakhulu kunomda wedosi esebenzayo ye-20 mSv ngonyaka kubasebenzi abaneminyaka emihlanu elandelelanayo. IKoeberg, umzekelo, ihlale ihlangabezana nomgomo wedosi ye-4 mSv kwixesha lophononongo ukususela ngo-2009 ukuya ku-2025, njengoko kubonisiwe kuUmfanekiso 14. Idosi ephakathi ingaphantsi kwe-1 mSv ngomsebenzi ngamnye ngonyaka.



Umfanekiso 14: Idosi engumndilili ngomsebenzi ngamnye ngonyaka (mSv) e-Koeberg

4.4.4 Umngcipheko we-X-ray

I-NNR ichaza iikhrayitheriya eziphambili zokhuseleko (imida yomngcipheko) ekufuneka ihambelane nayo i-nuclear facilities. Iikhrayitheriya eziphambili zokhuseleko ziikhrayitheriya zomngcipheko wonyaka kuluntu nakubasebenzi ngenxa yokuchatshazelwa zizinto ezine-radioactive ngenxa yeemeko eziqhelekileyo okanye zengozi.

Iikhrayitheriya zokhuseleko ze-NNR zifumaneka kwiltheyibhile 2 engezantsi.

Iltheyibhile 2: Imigaqo Yokhuseleko Ye-Nnr Kwiimeko Zeengozi

Iikhrayitheriya ze-NNR	
Umngcipheko Ophezulu Kawonke-wonke ²	I-5.00E-6 yokusweleka kwabantu ngonyaka
Umyinge Womngcipheko Woluntu Wonyaka ²	Izinga lokusweleka komntu ngamnye eliyi-1.00E-8 ngonyaka
Owona Mngcipheko Uphezulu Kubasebenzi Besiza ³	I-5.00E-5 yokusweleka kwabantu ngonyaka

² Umngcipheko oqhelekileyo woluntu kumntu ngamnye kuluntu luchazwa njengenani lokufa ngonyaka elahlulwe lilonke labemi belizwe.

³ Iingozi eziphezulu kunye nomndilili wabasebenzi zichazwa njengeengozi ezichaphazela abasebenzi abasebenza kwindawo yokusebenza ngenxa yokukhululwa ngengozi, ekubeni bonke abasebenzi bechaphazeleka kule ngozi, ihambelana neengozi eziphezulu kunye nomndilili wabasebenzi.

⁴ Iingozi eziphezulu kunye nomndilili wabasebenzi zichazwa njengeengozi ezichaphazela abasebenzi abasebenza kwindawo yokusebenza ngenxa yokukhululwa ngengozi, ekubeni bonke abasebenzi bechaphazeleka kule ngozi, ihambelana neengozi eziphezulu kunye nomndilili wabasebenzi.

likhrayitheriya ze-NNR				
Umyinge Womngcipheko Kubasebenzi Besiza	I-1.00E-5	yokusweleka	komntu	ngamnye ngonyaka

Umzekelo, iKoeberg Nuclear Power Station ibisebenza iminyaka engaphezu kwama-40. Isikhululo samandla kule minyaka idlulileyo sibonakalise ukuthobela imigaqo yokhuseleko ephambili kwaye sigcine umngcipheko ophezulu woluntu ungaphantsi kwe-3% yemigangatho ye-NNR (malunga nokufa kwe-1,1717E-07 ngonyaka) kunye nomngcipheko ophezulu wendawo yabasebenzi ungaphantsi kwe-20% yemigangatho ye-NNR (malunga nokufa kwe-7,56E 06 ngonyaka). Ukuze siqonde le ngcamango, umntu angacinga ngomngcipheko wokufa ngenxa yengozi yemoto (nokuba ngumqhubi, umkhweli, okanye umhambi ngeenyawo) eMzantsi Afrika. Ingxelo yonyaka yokhuseleko ezindleleni yaseMzantsi Afrika ka-2022 ibike ukuba abantu abayi-12 436 basweleke ngo-2022 ngenxa yeengozi zendlela [7]. Ngokusekelwe kubemi abazizigidi ezingama-60, umngcipheko ophakathi kukuba abantu abangama-21 kubemi abali-100000 (okanye i-2,1E-04 ngonyaka) banokufa kwingozi yendlela eMzantsi Afrika minyaka le. Oko kuthetha ukuba ilungu loluntu linamathuba angaphezu kwe-1 000 okufa kwingozi yendlela kunakwimeko yengozi yenyukliya eKoeberg.

Ukufumanisa umngcipheko kubemi nakubasebenzi kunye nokubonisa ukuthotyelwa kwemida yomngcipheko onokwenzeka njengoko kuqulethwe kwiMigqaliselo yoKhuseleko kunye neMikhwa yoLawulo (SSRP) [4] kwenziwa uvavanyo lweNgcipheko/uKhuseleko olunokwenzeka (PRA / PSA) lwesiza saseThyspunt kusetyenziswa amagama aqhelekileyo omthombo wesityalo seGeneration III kunye nedatha ethile yendawo. Uvavanyo lokhuseleko olunokwenzeka yindlela ecwangcisiweyo necwangcisiweyo yokuchonga nokuhlalutya iingozi ezinokubakho kuyilo kunye nemisebenzi ukuze kuphuhlisewe izisombululo zokunciphisa impembelelo yazo kwisityalo nakwindalo esingqongileyo, kuquka nabantu [10].

Uvavanyo lwenziwe kuthathelwa ingqalelo idatha yoluntu, iimeko zemozulu zesiza kunye neziganeko zangaphandle ezibalulekileyo kwindawo yaseThyspunt. Ubalo lweNgcipheko lwePC Cosyma lwenziwa ukuqikelela ukufa kwasekuqaleni nokufika kade ngebhendi yomgama ngamnye kwiCandelo ngalinye lokuKhululwa (RC). Emva koko ukufa kwasekuqaleni nokufika kade kwaqokelelwa ukuze kuchongwe ukufa okupheleleyo ngebhendi yomgama ngamnye. Ixabiso lilonke lokufa ngebhendi yomgama emva koko laphindaphindwa nge-frequency ye-RC enxulumeneyo, lahlanganiswa kuzo zonke iibhendi zomgama zazo zonke ii-RC kwaye lahlulwahlulwa ngabantu besizwe ukuze kufunyanwe umngcipheko ophakathi woluntu.

Umngcipheko ophezulu ufunyanwa ngokuphindaphinda inani lilonke lokufa kwi-2.25 km kwi-RC nganye nge-frequency yokukhululwa enxulumeneyo kwaye kwahlulwe isixa kuzo zonke ii-RC ngabantu abakumda wendawo.

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Umngcipheko uwonke wendawo ye-reactor yeeyunithi ezininzi uqikelelwa ngokuphindaphinda iziphumo ngenani leeyunithi.

Iziphumo zedosi, inani lokufa kunye neziphumo ezinxulumene nomsebenzi zivavanywe ngokwemigangatho yokhuseleko ye-NNR. Iziphumo ze-AP1000 zibonisa ukuba udidi lokukhululwa kwe-"Containment Bypass Failure" (BP) (RC) lulolona lunegalelo elikhulu kumngcipheko woluntu, kwaye ke ngoko lusetyenziselwe ukuvavanya idosi esebenzayo yeentsuku ezingama-30 yomntu ngamnye. Idosi esebenzayo ye-RC-Bypass ibalwa kwi-5.47E millisievert ngelixa idosi esebenzayo ye-EPR iqikelelwa kwi-94 millisievert kwidosi yomntu ngamnye yexesha elifutshane. Imilinganiselo ephakathi yexesha elide yomntu ngamnye kwizitho ezahlukeneyo kunye needosi ezisebenzayo ezibalwe ixesha leminyaka engama-50 emva kwengozi ibonisa idosi esebenzayo ye-1010 millisievert ye-AP1000 kunye ne-199E millisievert ye-EPR.

Umngcipheko wokufa kunye nemiphumo enxulumene nokusebenza kwesakhiwo esinjalo emva koko yathelekiswa nemigangatho yokhuseleko ye-NNR njengoko ichaziwe kwi-RD-0024 (jonga Itheyibhile 3 ngezantsi):

Itheyibhile 3: Uvavanyo lomngcipheko wonyaka lwesiza saseThyspunt ngenxa yesikhululo samandla enyukliya esisandula ukucetywayo

	AP 1000			EPR			
Umlinganise lo Womngcipheko	Umngcipheko Wonyaka Ngeyunithi Nganye	Umngcipheko Wonyaka (Ngesikhululo Ngasinye)	Ipesenti (%) Yeekhrayithe riya ze-NNR	Umngcipheko Wonyaka Ngeyunithi Nganye	Umngcipheko Wonyaka (Ngesikhululo Ngasinye)	Ipesenti (%) yeekhrayithe riya ze-NNR	likhrayither iya ze-NNR
Owona Mngcipheko Uphezulu Kuluntu	4.67 E-08	3.74E-07	7.5%	1.77E-08	1.06E-07	2.12%	5.00E-06
Umyinge Womngcipheko Woluntu	5.38E-12	4.28E-11	0.4%	4.43E-12	2.66E-11	0.27%	1.00E-08
Owona Mngcipheko Uphezulu Kubasebenzi Besiza	9.10E-07	7.28E-06	14.6%	5.50E-07	3.3E-06	6.59%	5.00E-05
Umyinge Womngcipheko Kubasebenzi Besiza	9.10E-07	7.28E-06	72.8%	5.5E-07	3.3E-06	32.97%	1.00E-05

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Ukusuka kwltheyibhile 3 kunokugqitywa kwelokuba uphando lwe-PSA lweNqanaba 3 olwenziwe ukuze kuchongwe ukuba ngaba imiqathango yokhuseleko ebekwe yi-NNR yeengozi kumalungu oluntu nakubasebenzi bendawo evela ekukhutshweni ngengozi kwi-reactors ezinokubakho kwindawo yaseThyspunt iya kuthotyelwa kwaye ngaloo ndlela ayibeki mngcipheko ungafanelekanga kuluntu nakwindalo esingqongileyo. Olu phononongo lufanelekile ngenjongo, kwinqanaba langoku lelayisenisi. Nje ukuba kuthathwe isigqibo malunga noyilo kunye netekhnoloji eza kubekwa kwindawo yaseThyspunt, kuya kwenziwa izifundo ze-PSA ezineenkukacha ukuvavanya umngcipheko ngokuchasene nemigangatho ye-NNR. Oku kuya kwenzeka kuphela kwinqanaba elilandelayo lelayisenisi.

5. INKCAZELO YESIZA NOKUXABISA

Ngokuhambelana neemfuno zomthetho zasekuhlaleni, ngakumbi i-RG-0011 (Isikhokelo sexeshana malunga nokuHlaliswa kweZibonelelo zeNyukliya) [6] kunye noMgaqo R.927 (Umgagqo-nkqubo wokunikezelwa kweLayisenisi yeZiza zoFakelo olutsha lweNyukliya) [1]], isicelo selayisenisi yendawo yenyukliya kufuneka siqwalasele ezi zinto zilandelayo kuvavanyo lokufaneleka kwendawo yesikhungo senyukliya:

- a) Iziphumo zeziganeko zangaphandle ezenzeka kummandla wendawo ethile (ezendalo nezibangelwa ngabantu);
- b) Iimpawu zendawo kunye nokusingqongileyo kwayo ezinokuchaphazela ukudluliselwa kwezinto ezikhupha imitha ye-radioactive ebantwini; kunye
- c) Ubuninzi kunye nokusasazwa kwabantu, kunye nezinye iimpawu ezinxulumene nokwenzeka kokuphumeza amanyathelo angxamisekileyo kunye nesidingo sokuvavanya umngcipheko kubantu ngabanye nakubemi.

Indawo ithathwa njengengafanelekanga ukuba ineziphene ezinkulu ezingenakubuyiselwa ngokusebenzisa:

- Iimpawu zoyilo;
- Amanyathelo okukhusela indawo; okanye
- Iinkqubo zolawulo.

Inkcazo emfutshane yendawo inikwe ngezantsi.

5.1 Inkcazelo yendawo yaseThyspunt

Le ndawo ikwicala lonxweme olusemazantsi, malunga neekhilomitha ezi-4 empuma yeOyster Bay, malunga neekhilomitha ezili-12 entshona yeSt. Francis Bay kunye neekhilomitha ezili-17,3 emazantsi eHumansdorp (umgama olinganiswa ukusuka kwindawo ephakathi ukuya kumda wedolophu okufutshane). Iindawo ezinkulu zasezidolophini zaseGqeberha naseKariega zikwindawo ephakathi kwe-80 km yengingqi.

Akukho ndlela zinqumla indawo. Indlela enkulu ye-N2 ihamba kwicala lasempuma-ntshona malunga neekhilomitha ezingama-22 emantla engingqi. Indlela etyaliweyo ikhokelela eHumansdorp kwaye indlela ephambili yokufikelela kwindawo yindlela yesibini engenamphezulu ekwimeko ephakathi ukuya eOyster Bay. Enye indlela yindlela engenye yokuhamba ngendlela engenamphezulu ukusuka kwindlela ye-R330 enetha ukusuka eHumansdorp ukuya eSt. Francis Bay.

Kukho umsebenzi omkhulu nobanzi kwezolimo kule ndawo, apho ekufutshane kukho amadlelo obisi ngaphakathi kwe-3 km kunye nezityalo ezinkcenkceshelwayo eziphakathi kumgama we-5 km ukusuka kwindawo ephakathi. Le ndawo iphakathi kwemilambo emibini, uMlambo iKrom kumantla-mpuma kunye noMlambo iSlang entshona kwindawo egcina amanzi e-quaternary

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K80F. Akukho milambo kwindawo ngokwayo kodwa kukho iindawo ezimanzi kunye nemithombo ebalulekileyo kwindalo, enye ikwindawo yeendunduma ezinezityalo nezihambayo kwaye enye ikwindawo yonxweme.

Le ndawo ijikelezwe emazantsi luLwandlekazi lwaseIndiya. Unxweme olunamatye lujonge phantse entshona-mantla-ntshona kunye nasempuma-mpuma-mpuma kwaye luneqonga elinqunyulwa ngamaza. Umhlaba ongaphakathi malunga ne-3 km uquka intsimi yeendunduma evelele enemiqolo ejikeleza empuma-mantla-mpuma ngenxa yemimoya ekhoyo. Umhlaba weendunduma zonxweme uneezityalo ngelixa kukho ummandla omxinwa welizwe weendunduma ezingezizo izityalo, ezihambayo ezisuka eOyster Bay ukuya eSt. Francis Bay. Ezi ndunduma zibizwa ngokuba ziindunduma zesanti ezitshintshayo.

Eyona nxalenye iphakamileyo yentsimi yendunduma imalunga ne-2 km ukusuka elunxwemeni kwaye inokuphakama okuphakathi kwe-100 m, kunye neendawo eziphakamileyo ze-111 m kunye ne-122 m. Iindunduma ezinezityalo eziphakathi kwale ndawo kunye nonxweme zimalunga ne-70 ukuya kwi-80 m ukuphakama zisihla ziye kwi-terrace engama-20 m ngaphezu konxweme olunamatye. Ngaphakathi ukusuka kwintsimi yendunduma, i-topography inyuka ngokulinganayo ukuya kwindunduma esezantsi ene-axis yayo ende ejonge kumntla-ntshona-mpuma kunye nendawo ephakamileyo ye-170 m. Le ndunduma inde imalunga ne-6 km ngaphakathi.

Iindunduma zeenqwelo moya ezikuloo mmandla ikakhulu ziindunduma zeenqwelo moya ezincinci kunye neendawo zokufika ezingxamisekileyo ezikwiifama. Uninzi lwezi zixhobo ezingabhaliswanga ezisetyenziselwa iinjongo zabucala ezingenazo izakhiwo okanye izakhiwo. Isikhululo seenqwelo moya esikhulu esikufutshane nendawo yiDavid Stuurman International Airport, ekwi-85 km empuma. Isikhululo seenqwelo moya esinye kuphela esisebenzayo esikwi-16 km ukusuka kwindawo, isikhululo seenqwelo moya saseSt. Francis (10,8 km empuma). Ibala leenqwelo-moya linendlela enye yengca eyi-10/28, enomlinganiselo we-1 000 X 23 m. Isebenza imihla ngemihla kwaye ayinayo inqaba yokulawula kodwa inezibane zokufika kwaye ithwala ii-hangers ezingama-20 zokugcina nokugcina iinqwelo-moya ezincinci zabucala. Akukho mafutha eenqwelo-moya okanye ezinye iikhemikhali eziyingozi ezigcinwa kule ndawo. Iinqwelo-moya eziqhelekileyo, oko kukuthi uhlobo lwepropeller, iihelikopta, kunye neejethi zeLear (< 5,7 t njengoko kuchaziwe yi-ICAO) zisebenzisa eli bala leenqwelo-moya kwaye malunga neentshukumo ezili-100 ngonyaka zirekhodwe. Okwangoku akukho zicwangciso zokwandiswa kweli bala leenqwelo-moya kwixesha elizayo. Akukho zixhobo zomkhosi ezikumgama we-80 km ukusuka kwindawo leyo.

Akukho mizila kaloliwe esebenzayo kufutshane nendawo. Icandelo lomzila kaloliwe iGqeberha–Avontuur Railway omfutshane, ongenambane, likwiikhilomitha ezingama-21,3 emantla endawo. Izithuthi zikaloliwe ziqulathe oololiwe abathathu abathwala imithwalo yedizili-electric ngeveki, abathutha imithi esuka eAssegaaibosch ukuya eGqeberha. Lo mzila ukwasetyenziswa yiApple Express, uloliwe wabakhenkethi basekuhlaleni. Akukho phuhliso

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Iweziseko zophuhliso lukaloliwe olucwangcisiweyo kwixesha elizayo ngaphakathi kwe-16 km yendawo.

Izibuko iGqeberha kunye neNgqura (Coega) zezona zibuko zorhwebo zikhulu kummandla obanzi kwaye zikwiikhilomitha ezingama-80 ukusuka kwindawo. Izibuko elincinci leenqanawa zasePort St. Francis likwiikhilomitha ezili-13,9 empuma. Liqulathe indawo yokukhusela amanzi enesitya sangaphakathi seenqanawa zokuloba zorhwebo, kunye neendawo zokubopha isamente, kunye necandelo (ngaphakathi kwezibuko) elinendawo yokubeka iinqanawa ezincinci zokuzonwabisa. Ubungakanani obukhulu benqanawa obunokufakwa yi-18 m, kunye nomthamo ongadluli kwi-3 m. Ukungena kwizibuko kulawulwa kukufikelela kwaye kuqeshwe umphathi wezibuko ukulawula esi sakhiwo.

Le ndawo iphantsi kommandla wolawulo lwamanzi weFish-Tsitsikamma. Nangona kunjalo, amanzi amaninzi angeniswa kwindawo ephezulu yolawulo lwamanzi e-Orange River ngoMlambo iSundays. Iindlela ezahlukeneyo zokugcina amanzi kunye nokudlulisa amanzi ezibonelela indawo yasekuhlaleni kunye noMasipala waseNelson Mandela Bay (NMBM) zibizwa ngokuba yinkqubo yokubonelela ngamanzi e-Algoa. I-NMBM ibonelela ngamanzi kubemi baseHumansdorp naseSt. Francis Bay ngombhobho weChurchill ovela kumadama aseChurchill naseImpofu (eyayisakuba yi-Elandsjacht) anomthamo we-26,3 kunye ne-32,1 yezigidi m3 ngokwahlukeneyo. Le mbhobho isebenza kwicala lasempuma-ntshona ukuya emazantsi omgaqo omkhulu we-N2 ukusuka kula madama ukuya eGqeberha, kunye nehlumelo eliya eSt. Francis Bay elidibanisa nendlela yetha yeHumansdorp-St. Francis Bay (R330) ngaphambi nje kwebhulorho yoMlambo iKrom. Iidolophu zasekuhlaleni zifumana inxalenye yonikezelo lwamanzi lwazo kwimithombo yamanzi angaphantsi komhlaba.

Umgca we-22 kV udlula kwi-0,4 km ukuya emantla endawo, onokubonelela ngombane we-8 MVA. Umgca omtsha we-66 kV uya kufuneka ukusuka kwisitishi esincinci saseSt. Francis Bay ukuya kwindawo, kwaye kulindeleke ukuba lo mgca uza kulandela indlela ecwangcisiweyo yokufikelela empuma ukusuka eSt. Francis Bay ukuya kwindawo. Umgca omtsha we-132 kV kufuneka unikezelwe ukusuka kwisitishi esincinci saseMelkhout (malunga ne-3 km emantla eHumansdorp) ukuya kwiyadi ye-HV ngaphesheya kweendunduma ukuze kubonelelwe nge-30 MVA kwindawo.

Ngokwembono yengingqi, utshintsho lokusetyenziswa komhlaba kummandla wendawo kulindeleke ukuba lugxile kwiindawo zokuhlala ezikhoyo nakwiindawo ezikufutshane. Naluphi na ukukhula okubalulekileyo okuya kwenzeka kuya kugxininiswa kwi-NMBM kwaye ngakumbi ukuya kwindawo ekhethekileyo yezoqoqosho yaseCoega. Ipateni yezolimo kunye nokunkcenkceshela kulindeleke ukuba ihlale ingaguquki. Iidolophu zonxweme kulindeleke ukuba zikhule ngokuhambelana nophuhliso lwezokhenketho kulo mmandla. Nangona kulindeleke ukuba kubekho ukukhula okuthile kwiindawo zokuhlala ezincinci kulo mmandla, kucingelwa ukuba kugxilwe kwiindawo zokuphumla eziselunxwemeni, apho kungekho phuhliso lubalulekileyo lwemizi-mveliso, ngaphandle kokufakelwa kwenyukliya kwindawo leyo, olucwangciselwe ixesha elizayo.

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Ingxelo yoKhuseleko lweNdawo yaseThyspunt [10] ibonelela ngenkcazo eneenkcukacha ngakumbi ngendawo yaseThyspunt.

5.2 Isakhiwo esicetywayo kunye noyilo lwesiza

Isakhiwo esicetywayo sesikhululo samandla, njengoko siboniswe kuUmfanekiso 15 (Impazamo! Umthombo wesalathiso awufumanekanga), siya kubandakanya, phakathi kwezinye izinto, ii-reactor zenyukliya kunye nezixhobo zazo ezincedisayo ezifana nezi:

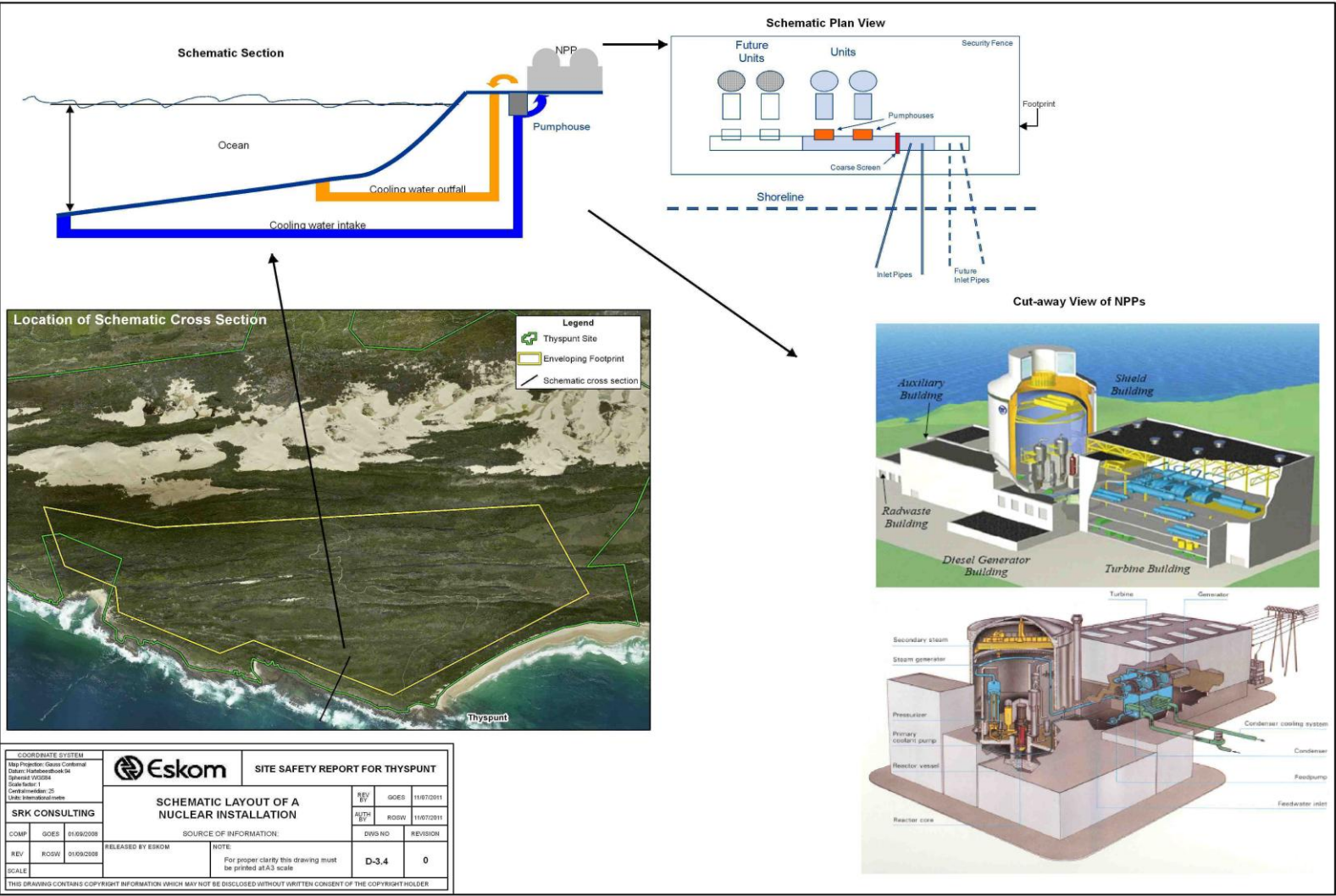
Ngexesha lokwakha:

- Umbhobho wexeshana wokungcola oya elwandle ukuze kwakhiwe; kunye
- Iindawo zokulala kunye nezinye iindawo eziza kucocwa ngexesha lokwakhiwa.

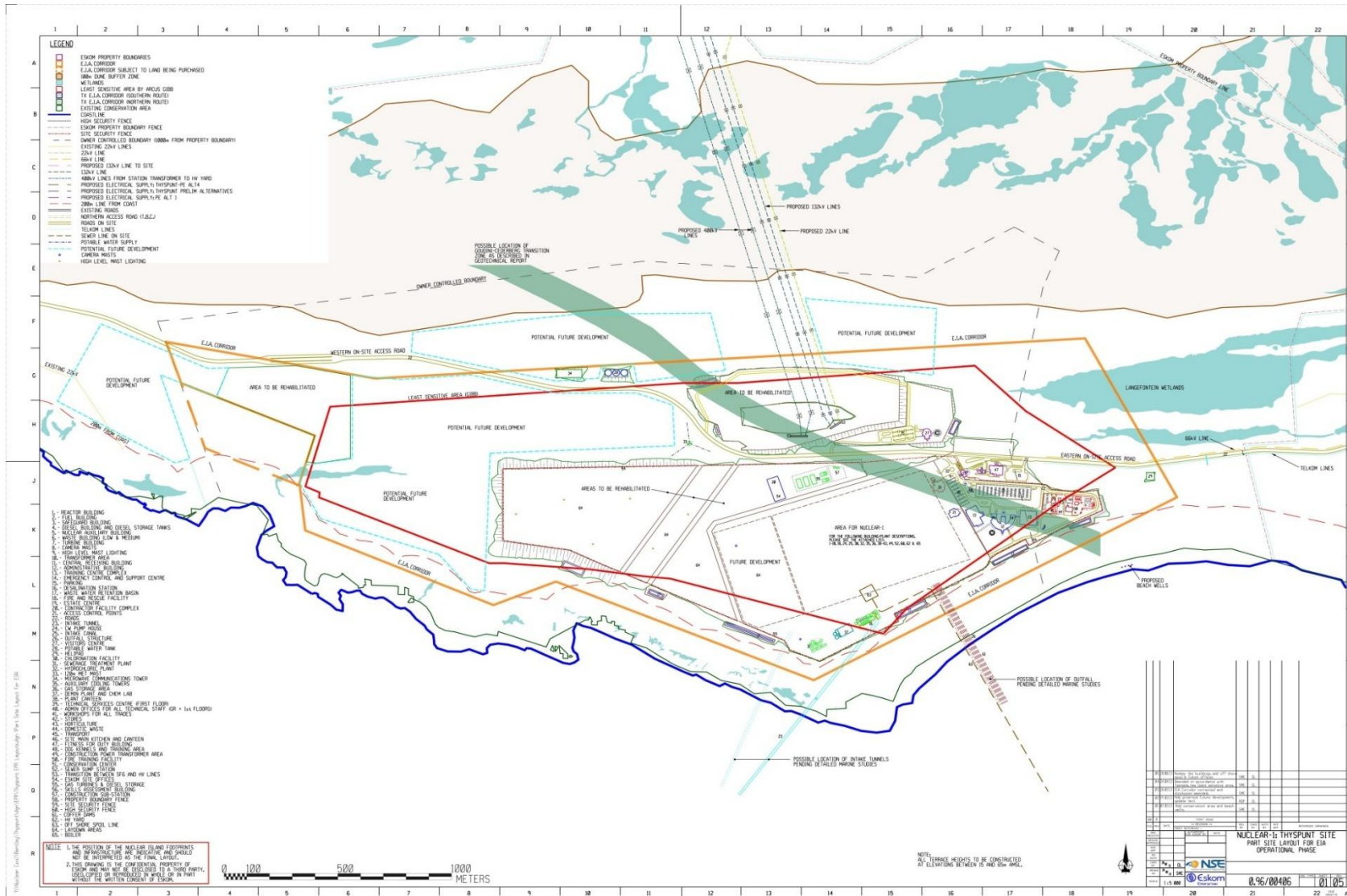
Ngexesha lokusebenza:

- Isakhiwo seReactor
- Izakhiwo ezincedisayo zeNyukliya
- Iihlo zeTurbine;
- Iindawo zokugcina amafutha asetyenzisiweyo okanye asetyenzisiweyo kunye nepetroli yenyukliya;
- Isityalo seHydrogen
- Iijenereyitha zeDizili negesi
- Iindawo zokugcina inkunkuma;
- Imisebenzi yokucoca amanzi amdaka;
- Izakhiwo zokungenisa nokukhupha amanzi elwandle ezifunekayo ukuze kufunyanwe/kukhululwe amanzi asetyenziselwa ukupholisa inkqubo;
- Isityalo sokususa ityuwa emanzini;
- Imigca yokuhambisa nokusasaza ye-132 kV kunye ne-400 kV ukusuka kwisikhululo samandla ukuya kwiyadi enevolthi ephezulu;
- Iindlela;
- Iyadi enevolthi ephezulu ye-400 kV kunye ne-132 kV (iyadi yeHV);
- Imigca yokuhambisa phakathi kwesikhululo samandla kunye neyadi yeHV (kuphela kwindawo yaseThyspunt); kunye
- Ezinye iziseko zenkonzo ezincedisayo (jonga kuUmfanekiso 16).

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Umfanekiso 15: Uyilo olucwangcisiweyo lofakelo lwenyukliya



Umfanekiso 16: Uyilo lwesiza saseThyspunt

5.3 Ukuxabiseka Kwesayithi

Uphando oluneenkukacha lwenziwe ukuqinisekisa ukufaneleka kwendawo yaseThyspunt, kuthathelwa ingqalelo zonke izinto ezifanelekileyo kwindawo leyo (oko kukuthi, iziganeko zangaphandle ezibangelwa yindalo nezibangelwa ngabantu, impembelelo enokubakho yeradiyoloji kuluntu nakwindalo esingqongileyo, ukuba kunokwenzeka ukuphuhlisa nokusebenzisa isicwangciso sengxamiseko kunye namalungiselelo okhuseleko afunekayo kwindawo leyo).

5.3.1 Uvavanyo lweziganeko zangaphandle

Iziganeko ezingaphandle kofakelo lwenyukliya ezinokubeka umngcipheko kukhuseleko lwenyukliya zichongiwe kwaye zavavanywa kwindawo leyo. Iindidi ezimbini eziphambili zeziganeko zangaphandle zezi:

- Iziganeko zemvelaphi yendalo, umz. izikhukula ezibangelwa yimozulu embi kwindawo leyo;
- Iziganeko zemvelaphi ebangelwe ngabantu, umz. ukungqubana kweenqwelo-moya ngengozi.

Iimfuno zangoku zomthetho ezifanelekileyo zokuvavanya iziganeko zangaphandle ngexesha lokuchazwa kwendawo yofakelo olutsha lwenyukliya zichazwe kumaxwebhu amabini alandelayo:

- R.388 (*Imigangatho yoKhuseleko kunye neMisebenzi yoLawulo*) [4]; kunye
- R.927 (*Imigaqo yoNikezelo lweLayisenisi zeZiza zoFakelo olutsha lweNyukliya*) [1].

Imigaqo eku-R.927 ebhekisa kwiziganeko zangaphandle yile:

“4(2) Uyilo(ii) lofakelo lwenyukliya olucetywayo, kunye neempawu ezithile kwindawo leyo: Ufakelo(ii) olutsha lwenyukliya kufuneka lubonakalise ngoyilo lwalo, ulwakhiwo kunye nokusebenza amathuba aphantsi amkelekileyo eziganeko ezicingelwayo ezinokubangela ukukhululwa kobuninzi bezinto ezine-radioactive.”

“4(3) Indawo yesiza kunye neempawu zokhuseleko ezicwangcisiweyo zazo zonke izinto ezifakelweyo zenyukliya, ezibandakanyiweyo njengeendlela zokhuseleko ngokuchasene nemiphumo eyingozi yeziganeko ezicingelwayo, kufuneka ziqinisekise umngcipheko ophantsi owamkelekileyo wokuvezwa luluntu.”

“4(4) Indawo kufuneka ibe ngendlela yokuba iidosi zemitha kunye neengozi ezivela ekusebenzeni okuqhelekileyo kunye neziganeko ezicingelwayo ezinxulumene nazo zonke izinto ezifakelweyo zenyukliya ezikufutshane ziya kuba sezantsi ngokwamkelekileyo.”

“4(5) Iziganeko zendalo kunye neengozi ezinokubakho ezenziwe ngabantu kufuneka ziqwalaselwe ngokufanelekileyo kuyilo lwezixhobo ezintsha zenyukliya, kwaye izicwangciso zongxamiseko ezifanelekileyo kunye namanyathelo okhuseleko lwenyukliya zinokuphuhliswa.”

“5(3) limpawu zesiza ezifanelekileyo kuvavanyo loyilo, umngcipheko kunye nokubalwa kwemilinganiselo, kubandakanya phakathi kwezinye izinto:

- a) iziganeko zangaphandle;*
- b) idatha yemozulu;*
- c) ukusetyenziswa komhlaba;*
- d) inani labantu;*
- e) uphuhliso lwengingqi;”*

“5(4) Uhlalutyo lwegama lomthombo olumele iingozi ezinokubakho kuluntu nakwindalo esingqongileyo ngenxa yokufakelwa kwenyukliya entsha. Ububanzi obumele iziganeko zangaphakathi nezangaphandle ezigubungela ukufakwa kwenyukliya entsha kufuneka buthathelwe ingqalelo.”

5.3.2 Ingozi Zendalo

Iziganeko zivavanywa ngohlalutyo lwedatha yokubeka esweni ekhoyo yendawo kunye nokumisela izibalo zeziganeko eziphindaphindayo. Ezi zibalo zixesha lokubuyela kunye namathuba onyaka okugqitha amaxabiso eeparameter abonisa ubunzima besiganeko.

5.3.2.1 Ingozi yokwakhekha komhlaba

Uphando lwejoloji kwindawo yaseThyspunt luye lwenziwa iminyaka engaphezu kwama-25. Olu phando luquke imephu yejoloji, izifundo zejoloji ezikwi-naselwandle, uhlalutyo lwe-geochronological, izifundo zejoloji, izifundo ze-paleoseismic, kunye nophando lwejoloji.

Olu phando lwenziwe njengenxalenye yezifundo zokuhlola zakuqala ukuvavanya iindawo ezininzi zenyukliya, izifundo ezithile ezenziwe kwindawo yaseThyspunt, kunye nophando lwejoloji olwenziwe ngokukodwa ukujongana nemiba ebalulekileyo ebalulekileyo kuhlalutyo lweengozi ze-seismic. Ngokuhambelana nesikhokelo se-NNR kunye nesikhokelo solawulo lwamazwe ngamazwe kunye nemigangatho, uluhlu olupheleleyo lweendlela kunye nezixhobo lusetyenzisiwe, kwaye uphando luquke amaqanaba aphakanyisiweyo okwanda okucacileyo ukusuka kummandla wendawo, indawo ekufutshane, kunye nendawo yendawo ukuya kwindawo yendawo. Njengoko kucetyiswa kwisikhokelo solawulo esikhoyo, iziphumo zophando olwenziwe kwindawo zihlanganiswe nezifundo ezenziwe linani elikhulu labaphandi ngaphakathi kuluntu lwejoloji kwaye zapapashwa kwiincwadi zobungcali.

Isiphumo esipheleleyo sokudibanisa zonke izifundo zejoloji ezenziwe kunye nokutolika okunikezelwa ngamalungu oluntu kwiimpapasho zobugcisa sisiseko solwazi oluqinileyo nolupheleleyo lwejoloji kummandla wendawo, indawo ekufutshane, indawo yendawo, kunye nendawo yendawo.

I-geology yengingqi eselunxwemeni nangaselunxwemeni kunye ne-tectonics kwindawo ziqondwa kakuhle. Unxweme kunye nethafa eliselunxwemeni kwindawo nendawo zimela indawo endala nezinzileyo. Ngokwembono ekhukulisekayo, amatye anganyangekiyo aseka olu nxweme lunamaqhubu anika isiseko esizinzileyo sokwakhiwa kwezixhobo zenyukliya.

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Utshintsho olukhulu kwimeko-bume ye-geological alunakwenzeka kakhulu. Ngenxa yendalo yelitye elityebileyo le-silica (amatye esanti kunye namatye e-silt) le-Palaeozoic-age bed esezantsi kwendawo yendawo, akukho mngcipheko wokuba kubekho imingxunya yesisombululo phantsi kwendawo.

5.3.2.1.1 Ukungazinzi kwethambeka

Indawo kunye nommandla okufutshane nayo zivavanyiwe ukuze kuchongwe ukuba kunokwenzeka na ukuba kubekho ukungazinzi kwethambeka (njengomhlaba kunye nokuqengqeleka kwamatye) okunokuchaphazela ukhuseleko lofakelo lwenyukliya.

Ukungazinzi kwethambeka yinto ebangelwa ziithambeka ezinde, amanzi angaphantsi komhlaba aphezulu, kunye/okanye intshukumo yomhlaba eshukumayo kodwa ayinxulumananga nokuqhekeka komphezulu. Ukungazinzi kwethambeka kunokubangela ukudilika komhlaba kunye neentshukumo zomhlaba ngokubanzi ezinokuchaphazela ukusebenza ngokukhuselekileyo kofakelo lwenyukliya. Kunokuthintela impendulo engxamisekileyo.

Iprofayili ye-geotechnical yendawo ineengqaqa ezigqunywe yintlabathi ye-Aeolian engenako ukuhlangana ebanzi ukusuka kwi-0 m kwinqanaba lolwandle ukuya kutsho kwi-65 m phantsi kweencochoyi zentlabathi ngaphakathi elizweni (malunga ne-700 m ngaphakathi elizweni ukusuka elwandle). Kukwakho ne-aquifer ephakathi kwee granular efumaneka kumphezulu (okanye kufutshane) kwinqanaba lolwandle kwaye inzulu njenge-60 m ukusuka kumphezulu phantsi kweencochoyi zentlabathi ngaphakathi elizweni.

Iprofayili ye-geotechnical echaziweyo ibonisa ukuba ngelixa intlabathi ye-Aeolian engenako ukuhlangana kunye namanqanaba aphantsi komhlaba atshintshayo afuna uvavanyo lokuzinza kwentlabathi yendawo, ezi meko azibeki mqobo uphambili kwindawo. Amandla okungazinzi kwethambeka aza kuvavanywa ngokusebenzisa imodeli ye-geotechnical yamandla okucheba isanti, indlela esebenza ngayo amanzi angaphantsi komhlaba, i-geometry yokwemba kunye nomthwalo we-seismic, kwaye naziphi na iingozi ezichongiweyo ziya kuncitshiswa ngoyilo lobunjineli bokwakha, ngokuhambelana neemfuno zomthetho.

5.3.2.1.2 Ukudilika, Ukuwa, okanye Ukunyuka koMphezulu weNdawo

Iimaphu zejografi kunye nolunye ulwazi olufanelekileyo lommandla zihlolwe ukuba zikhona na iimpawu zendalo ezifana nemiqolomba, ukwakheka kwekarstic, kunye neempawu ezenziwe ngabantu ezifana nemigodi, iingcango, kunye nemithombo. Kuhlolwe amathuba okuwa, ukwehla, okanye ukuphakama komphezulu wendawo.

Le ndawo iphantsi kwelitye lesanti leTable Mountain Group (TMG) elilawulwa yiSkurweberg (kufutshane nolwandle) kunye nokwakheka kweGoudini (ngaphakathi ngakumbi). Ezi zakhiwo azinazo naziphi na iimpawu ezibonakalayo ezinokubangela ukuphuhliswa kweendawo ezingaphantsi komhlaba (umz. imiqolomba) kunye neempawu zekarst (eziphuhla kwelitye lekalika/idolomite). Iinkqubo zokumba ezininzi ezenziwe kule ndawo azizange zihlangabezane nazo naziphi na iindawo ezingenanto okanye iimpawu zekarst ezinokubangela iingozi zangaphandle kwindawo.

Ezi mpawu zilandelayo zithathwa njengezinobungozi ekufakweni kwenyukliya:

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- Izalathisi zemingxunya enokubakho kunye nokuchaphazeleka kokuwa komhlaba kwimeko yezinki, amachibi esinki, imiqolomba kunye nemiqolomba, imilambo etshonayo, ukuhla komhlaba okudlulileyo, iibhulorho zendalo, iindawo ezingaphantsi komhlaba, imithombo, iintlobo zamatye afana nelimestone, idolomite, igypsum, ianhydrite, ihalite, umhlaba we-terra rossa, i-lavas, amatye e-classic aqinileyo, amalahle okanye i-ores; kunye nokungahambelani kwamatye anyibilikayo;
- Iindawo zobuthathaka okanye ukungaqhubeki kwamatye ekristale.

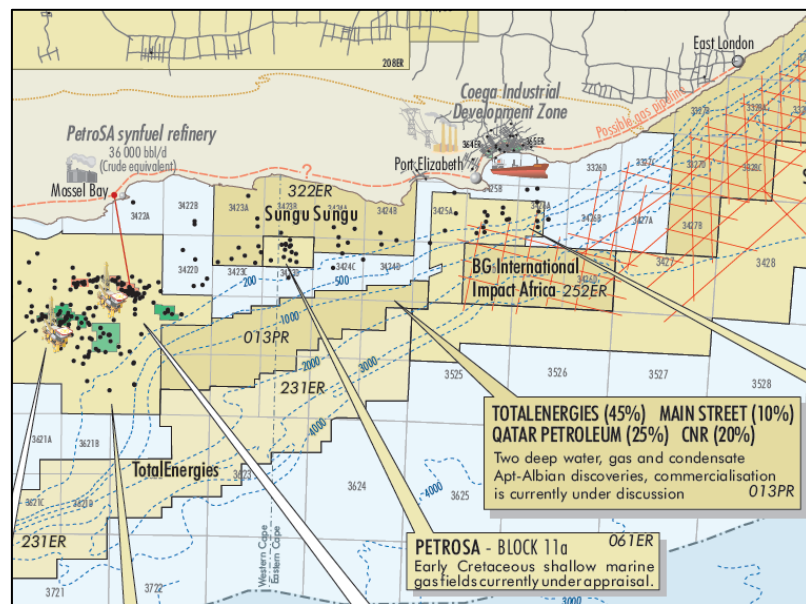
Ulwazi oluqokelelwe ukuza kuthi ga ngoku kuphando lwembali nolubanzi oluphazamisayo kwindawo, lubonisa ukuba akukho zimpawu ezinokuba yingozi ekufakweni kwenyukliya ezikhoyo kwindawo. Ukongeza, njengoko ukufakwa kwenyukliya kucetywa ukusekwa phezu (okanye ngaphakathi) kwedwala, akukho kuhla, ukudilika, okanye ukuphakama okulindelweyo kwindawo ngexesha lokuphila kwesakhiwo.

Imisebenzi yokwemba ngaphakathi kwe-16 km ukusuka kwindawo ithathelwe ingqalelo ukuchonga imithombo enokubakho yeziganeko ezibangelwa ngabantu. Uvavanyo lwendawo lugqibe kwelokuba akukho misebenzi yokwemba ngaphakathi kwe-16 km radius yendawo enokuchaphazela uzinzo lomphezulu.

Inani elincinci leemigodi, imigodi yesanti, kunye namasimi ezitena afunyenwe kwindawo yendawo zinxulumene ngokuthe ngqo nomzi-mveliso wokwakha kwaye zenzeka kwiindawo ezikufutshane needolophu ezikhoyo apho uninzi lolwakhiwo olutsha lwenzeka khona.

Imigodi/imithombo yemveliso kuya kufuneka ibekwe kufutshane nofakelo lwenyukliya ukuze ibe naziphi na iziphumo ezinokubakho ngenxa yokutsalwa kwamanqanaba amanzi angaphantsi komhlaba ngokusekelwe kuvavanyo lwesivuno olwenziwe kwindawo.

I-Southern Outeniqua Basin, engaphandle kwindawo yesiza, ikumgangatho ophezulu kumafutha enkungu phakathi nasezantsi kwe-basin kwaye inamathuba amaninzi egesi ekubeni nkqo kwingingqi yasembozo. I-Algoa Basin, nayo engaphandle kwendawo yesiza iqulathe amafutha enkungu, ngelixa i-Gamtoos Basin, ekwiindawo zesiza ibonisa ukuba inamathuba egesi kwaye i-Pletmos Basin inezinto ezifakazelwe zegesi. Kwii-Southern Outeniqua Basin, iziseko ezibalulekileyo zegesi ziqinisekisiwe kutshanje ngokujonga emafuthwini ee-Brulpadda nase-Luiperd yi-TotalEnergies, i-Main Street, Qatar Petroleum kunye ne-CNR [10]. Umfanekiso 17 ubonisa iindawo ezifanelekileyo zeelayisense ngaphakathi kwindawo yesiza.



Umfanekiso 17: Imisebenzi yokukhangela kunye nokukhiqiza ipetroli malunga nendawo yendawo

Okwangoku kukho amalungelo amabini okuphanda apha phesheya aphantsi komsebenzi kwisithuba sendawo, oko kukuthi iSungu Sungu apho iPetroSA iphumeza uvavanyo lwemibhoshongo yegesi yaselwandle yeCretaceous, kunye neNew Age Algoa/Rift Petroleum apho uvavanyo lokuba kukho amathuba kwii-synrift nakwi-post rift sequences luyaqhubeka.

Ngaphezu koko, i-TotalEnergies, i-Main Street, i-Qatar Petroleum kunye ne-CNR babesazi izibophelelo zokusebenza phantsi kwesicelo ngqo kubuma beendawo ezingasempuma. Le projekthi ibisendaweni yokuvunywa kwaye bekulindlele ukuba iqale ukuhamba ngokurhweba ngo-2026, kodwa, ngoJulayi 2024, i-TotalEnergies, i-Main Street Qatar Energy kunye ne-CNR yazisa amaqabane e-joint venture ukuba baya kutsiba kumdlawabo. I-Main street yaya igcina umdlawabo. Ukuxhaphaza kwexesha elizayo kwale mveliso ke akucaci kwaye kuya kufuneka kuqwalaselwe.

Ngokusekelwe kulwazi lwangoku malunga nendawo kunye nendawo ekuyo, akulindlekanga ukuba kuqubuke, kungene ngaphantsi okanye kudakwe umphezulu wendawo ngenxa yokwakheka kweemgodi kunye neekarst ngexesha lobomi besikhululo samandla enucleya. Ukukhupha igesi kwixa elizayo kufuneka kulandelwe kwaye kuhlolwe impembelelo yakhona kwindawo xa kukho ulwazi olungakumbi.

5.3.2.1.3 Ukunyibilika koMhlaba

Amandla okunyibilika kwezinto ezingaphantsi komhlaba kwindawo ecetywayo avavanywe ngokusebenzisa iiparameter kunye namaxabiso okushukuma komhlaba kwindawo ethile. Uvavanyo luquke ukusetyenziswa kweendlela ezamkelekileyo zophando lomhlaba kunye neendlela zokuhlalutya ukufumanisa iingozi. Umonakalo omkhulu unokwenzeka kwizakhiwo zasekuhlaleni ezixhaswa kumhlaba onyibilika ulwelo.

Ngokusekelwe kulwazi olukhoyo ngoku malunga nendawo kunye nommandla wayo, akulindlekanga ukuba kubekho ukuwa komhlaba, ukugungqa okanye ukuphakama

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komphezulu womhlaba kule ndawo ngenxa yokwakheka kwemingxuma yangaphantsi komhlaba kunye neekharsti ngexesha lobomi besixhobo senyukliya. Ukutsalwa kwezibonelelo zegesi kwixesha elizayo kufuneka kubekwe esweni kwaye kuvavanywe ngokubhekiselele kwimpembelelo yako kule ndawo xa ulwazi olongezelelekileyo sele lufumaneka.

5.3.2.1.4 Intaba-mlilo

Iziganeko zentaba-mlilo zinokubeka iingozi ezinkulu kwindawo efakelwe inyukliya ngexesha lokuphila kwayo. Njengesikhokelo esiqhelekileyo, iintaba-mlilo eziqhume kwiminyaka eli-10 000 edlulileyo zihlala zithathwa njengezisebenzayo. Ulwazi malunga novavanyo lwentaba-mlilo enokubakho kwindawo yesiza lubonisa ukuba intaba-mlilo yenzekile kulo mmandla kwiminyaka engaphezu kwezigidi ezili-10 eyadlulayo, nto leyo ethetha ukuba zinokuthathwa njengezingasebenziyo.

5.3.2.1.5 Indlela yokuziphatha kwezinto ezisisiseko

Iimpawu zejografi zezinto ezingaphantsi komhlaba, kuquka ukungaqiniseki, ziphandwe kwaye iprofayili yomhlaba wesiza ngendlela efanelekileyo kwiinjongo zoyilo yafunyanwa. Uzinzo lwezinto ezisisiseko phantsi komthwalo ozinzileyo nowenyikima luvavanyiwe. Ulawulo lwamanzi angaphantsi komhlaba kunye neempawu zeekhemikhali zamanzi angaphantsi komhlaba nazo zafundwa.

Uphando olunzulu lwesiseko sendawo ngokusebenzisa uphando lwasendle naselabhoratri lutyhile ukuba indawo iphantsi kwe-quartzitic eqinileyo (elawulwa yintlabathi) amatye okwakheka kweSkurweberg emazantsi kunye namatye okwakheka kweGoudini angaqinileyo kangako (elawulwa yintlabathi ye-quartzitic) kwiindawo eziphakathi nasemantla zesiza.

La matye anqunyulwe kakhulu kwaye aguquguquka ngenxa yomsebenzi we-tectonic wangaphambili kwaye indawo ngokwayo ikwicala elisezantsi le-anticline. Amatye eTable Mountain Group (TMG) angaphantsi kwesiza atshona malunga nama-50° emazantsi. Njengoko evela kwi-sedimentary, kuyacaca ukuba iprofayili ye-weathering yala matye iyahluka kakhulu kuyo yonke indawo kwaye oku kuguquguquka kuchaphazeleka ziimpawu ze-depositional kunye nokungafani kwamatye aguqukileyo.

Amatye okwakhiwa kweSkurweberg kunye neGoudini abonakala eneempawu ezahlukeneyo ezinxulumene namandla oxinzelelo lwe-uniaxial (UCS). Ngokwenyani, amatye okwakhiwa kweSkurweberg adla ngokuba ne-UCS ephakathi ephezulu kuneematye okwakhiwa kweGoudini. Ukusasazwa kwe-UCS kumatye eSkurweberg kugubungela ukusasazwa kwe-UCS kumatye eGoudini.

Ukuthelakiswa kweemfuno zeempawu zomhlaba wesiseko ngokubanzi zokufakelwa kwenyukliya kunye nedatha ekhoyo ngoku yendawo ayibonisi mqobo ekwakheni iziseko zokufakelwa kwenyukliya (okanye ngaphakathi) kwelitye lesiza.

5.3.2.2 Uhlahutyo lweeNgozi zeNyikima olunokwenzeka i-PSHA

Uhlahutyo lwengozi ye-seismic enokwenzeka ye-Thyspunt (PSHA) [9]], oluphawule ingozi ye-seismic kwindawo yaseThyspunt, lulandele iimfuno kwaye lwalandela iindlela ezivunyiweyo

kwaye zavunywa yiKhomishini yoLawulo lweNyukliya yase-United States, kuba ezi zazithathwa njengezona mfuno zingqongqo zolawulo kwiHlabathi liphela. Ngaloo ndlela i-PSHA yanelisa neemfuno kunye nemigangatho ye-IAEA kunye ne-NNR. Ngoko ke, i-Thyspunt PSHA yenziwe njengophando lwe-SSHAC Level 3, olubhekisa kwinkqubo eneenkcukacha, esemthethweni yokwenza i-PSHA.

Njengazo zonke izifundo ze-SSHAC, i-Thyspunt PSHA yayichaze ngokucacileyo iindima zabo bonke abathathi-nxaxheba, ngomsebenzi wobugcisa owenziwa liqela lobugcisa elinamacandelo amaninzi. Uxanduva lwenkqubo kunye nophononongo lobuchwephesha lwabelwa iPhaneli yoHlobo loNcedo oluBandakanyayo (PPRP) olunezakhono eziphezulu kunye namava, eyayinoxanduva lokugqibela lokuqinisekisa ukuba uphando lufumene, kwaye lubhalwe ngokufanelekileyo, idatha ekhoyo, iimodeli kunye neendlela. I-Thyspunt PSHA isebenzise isiseko sedatha seprojekthi esipheleleyo, yenze uqokelelo lwazo zonke iinkcukacha ezikhoyo ezichongiweyo ngamaQela e-Technical Integrator (TI), incediswa ziingcebiso ezivela kwi-PPRP, kwaye yaquka amaphepha apapashiweyo, iingxelo ezingapapashwanga, iirekhodi zeemaphu, iikhathalogu, kunye nolunye ulwazi olunobungakanani. Inkqubo ye-SSHAC Level 3 ikwabonelela, ngeeworkshops ezisesikweni, ukuba iqela lezobugcisa lisebenzisane ngokuthe ngqo namalungu oluntu lwezenzululwazi malunga nolwazi kunye neemodeli ezithile kunye nokutolikwa okufanelekileyo kwi-PSHA.

Ukongeza, kwenziwa izifundo ezininzi zeengcali ukuqokelela idatha eyongezelelweyo enegalelo ekuthinteleni ngcono iimodeli zezenzululwazi, ngaloo ndlela kunciphisa ukungaqiniseki ngokubanzi kwe-epistemic. Ezi ziquka inani lezifundo ezigxile kwiindawo ezinkulu zeKango, Bavianskloof, Coega kunye neKouga, kunye nophando lwe-marine terrace olugxile kwiThyspunt kunye nommandla ojikelezileyo. Olu phando lusebenzise kwaye longeze idatha yolwandle kwaye lwagxila kuphando kwiKango Fault eyayigunyaziswe ngaphambili yi-Eskom (yaza kamva yapapashwa kwiincwadi zezenzululwazi). Uphando lokuqala, olubanzi lweengxelo zenyikima zembali (zangaphambi kwezixhobo) lwenziwe eMzantsi Afrika, ukongeza kwisiseko sedatha sezixhobo zekhathalogu yenyikima. Ukulinganiswa kweJootechnical, kubandakanya i-non-invasive MASW (Multi-channel Analysis of Surface Waves) kunye nokufakwa kwe-PS suspension kwimigodi engama-26, kwenziwe kwindawo yaseThyspunt ukuvavanya iimpawu eziguqukayo ze-profayili yelitye elikufutshane nomphezulu.

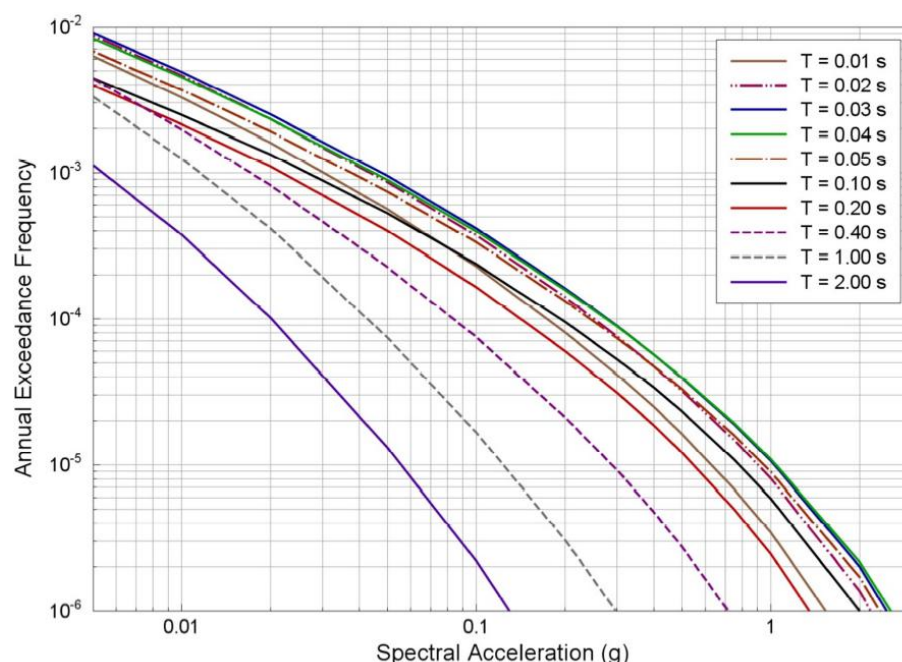
Iimodeli yomthombo wenyikima yimbonakalo yengqiqo neyezibalo yeempawu zomzimba zemithombo yenyikima ezithathwa njengezinako ukuvelisa iintshukumo zomhlaba ezibalulekileyo kwindawo leyo. Iindidi ezimbini zemithombo yenyikima ziqwalaselwe kwiThyspunt PSHA; iimpazamo zejoloji ezaziwayo kunye neendawo zemithombo yenyikima. Ezi zokugqibela zichaza imimandla yoqweqwe loMhlaba apho umsebenzi wenyikima unokwenzeka khona ngaphandle kokukhawulelwa kwiimpazamo ezithile ezaziwayo. Iimodeli yokugqibela yomthombo yayiquka imithombo elishumi yenyikima, eyayiquka iindawo ezintlanu zemvelaphi (i-Extended Continental Crust [ECC, indawo yokusingatha], i-Syntaxis [SYN], i-Karoo [KAR], i-Namaqua [NAM], kunye ne-Cedarville-Koffiefontein [CK]), kunye nemithombo emihlanu yempazamo, eyayiquka iimpazamo ze-Kango (KNG), i-Agulhas (AFZ), i-Gamtoos (GAM), i-Plettenberg (PLET), kunye ne-Worcester (WOR). Imithi ye-logic yaphuhliswa ukuze ibambe iimpawu zale mithombo. Kwiindawo zemithombo yenyikima ezi mpawu zaziquka

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indawo kunye nohlobo lwemida yazo, inani leeparameter ezinxulumene nobukhulu obukhulu, ukujongwa kokuqhekeka kwenyikima okunokwenzeka ngaphakathi kwendawo nganye, kunye neempawu zokuphinda kubuye inyikima. Kwimithombo yempazamo oku kwakuquka amathuba ayo e-seismogenic, isitayile se-faulting, i-geometry enemilinganiselo emithathu, ubukhulu beempawu, amazinga okutyibilika, ubudlelwane be-magnitude-frequency, kunye namazinga okuphinda kubuye inyikima. Kwenziwe olunye uphawu lwe-Kango fault, eyayiphantsi kophando olukhulu lwe-paleoseismic.

Kwimodeli ye-GMC (uphawu lwentshukumo yomhlaba), iQela le-TI liphonononge zonke ii-equations zokuqikelela ukuhamba komhlaba (ii-GMPE) ezikhoyo kwaye lagqiba ekubeni lihlengahlengise kwaye lilungise ii-equations ezikhoyo ukuze zihambelane neemeko zasekuhlaleni. Kule ndlela ye-hybrid-empirical parameters stochastic isetyenziselwa ukusebenzisa uhlehlengiso lwengingqi ye-host-to-target kwi-GMPEs ezisemgangathweni. Uhlalutyo lwempendulo yendawo lwenziwe ukuphuhlisa imisebenzi yokukhulisa ukudluliselwa kweentshukumo ze-bedrock kubunzulu ukuya kumphezulu we-bedrock kwindawo leyo.

Ubalo lwengozi lwenziwe kusetyenziswa iphakheji yesoftware efanelekile yenyukliya i-FRISK88. Ubalo oluzimeleyo lwamasebe amaninzi e-logic-tree lwenziwe ngaphandle njengovavanyo oluzimeleyo ekusetyenzisweni kwemodeli yomthombo we-seismic kunye nentshukumo yomhlaba. Isiphumo esisiseko esivela kwi-PSHA yayizii-hazard curves ezibonisa i-annual frequency of exceedance (AFE) yamaxabiso ahlukeneyo e-spectral accelerations kula maxesha okuphendula. Ubalo lwengozi lwenziwa kwixesha le-10 target oscillator elichongiweyo ngaphambili kunye noluhlu olubanzi lwe-AFE, zivelisa ii-hazard curves ezahlukeneyo ekuphakameni kumphezulu njengoko kubonisiwe kuUmfanekiso 18 ngezantsi.

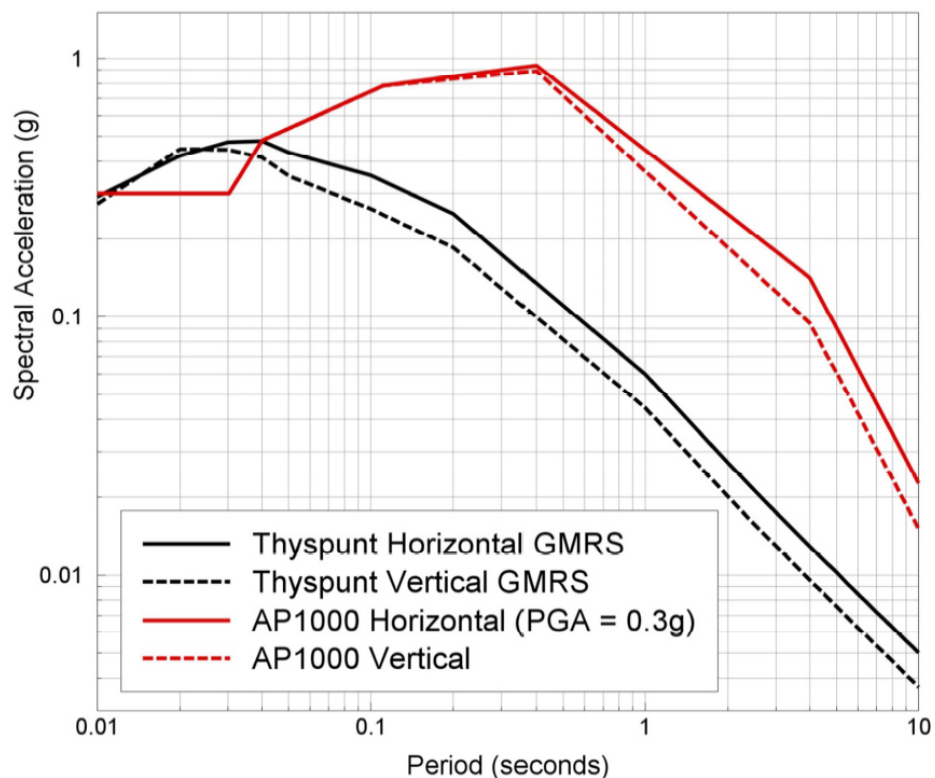


Umfanekiso 18: ligophe zeNgxaki eziPhakathi kwindawo ePhakamileyo

liploti zokwahlulahlula zenziwe kwiindidi ezahlukeneyo zexesha lokuphendula kunye ne-AFE, ukuvavanya impembelelo yeendidi ezahlukeneyo zobukhulu benyikima, umgama ukusuka

kwindawo ukuya kwindawo kunye nenqanaba lokuhamba komhlaba (ngaphakathi kokusasazwa okunokwenzeka kokukhawulezisa okuqikelelwe zii-equations zokuhamba komhlaba ngobukhulu kunye nomgama othile).

Kwii-curves ze-seismic hazard, ii-spectra ze-uniform hazard response spectra (UHRS) zakhiwe kwii-AFE ezahlukeneyo. Esinye isiphumo esivela kolu phononongo yayizii-ratios ze-vertical to horizontal spectral coordinate ezinokusetyenziselwa ukufumana ii-spectra zempendulo ezithe nkqo kwi-spectra yempendulo ethe nkqo kwaye zifunyanwa ngokusebenzisa inguqulelo eguquliweyo ye-V/H ratios kwiindawo ze-hard rock kuMbindi naseMpuma United States eziboniswe kwi-NUREG/CR-6728 (Bhekisa ku[9]. Xa i-GMRS ethe nkqo nethe nkqo (i-ground motion response spectra) ethe tye ithelekiswa ne-standard AP1000 design spectra (jonga umfanekiso ongezantsi), kukho umda obonakalayo phakathi kwe-Thyspunt GMRS kunye ne-AP1000 design spectra. I-spectrum yoyilo idlulwa kuphela ngamaxesha amafutshane e-oscillator, nto leyo ebonisa ukungalingani okwaziwayo kwe-standard design spectra esetyenziswa kwiindawo ze-hard rock ngelo xesha, okungafanele ukuba ihlale ingaphezulu kwee-frequency eziphantsi njenge-40 Hz high oscillator frequency (ukusuka kwi-25Hz ukuya ngaphantsi kwe-100Hz), into eqhelekileyo kwiindawo ze-hard rock (Bhekisa kuUmfanekiso 19).



Umfanekiso 19 : I-GMRS yeThyspunt xa ithelekiswa ne-spectrum yoyilo lwe-AP1000

5.3.2.2.1 Ukuququzelela Kwemisinga Emiseismic Eyenziwe Ngumsebenzi Wemingxuma

EMzantsi Afrika kuye kwaqhutywa ziimfazwe zomhlaba eziphuma kuzo zonke iindidi zemvelo (i-tectonic) kunye nezo zidibene nemigodi. Ngokweemfuno zokuvavanywa komngcipheko

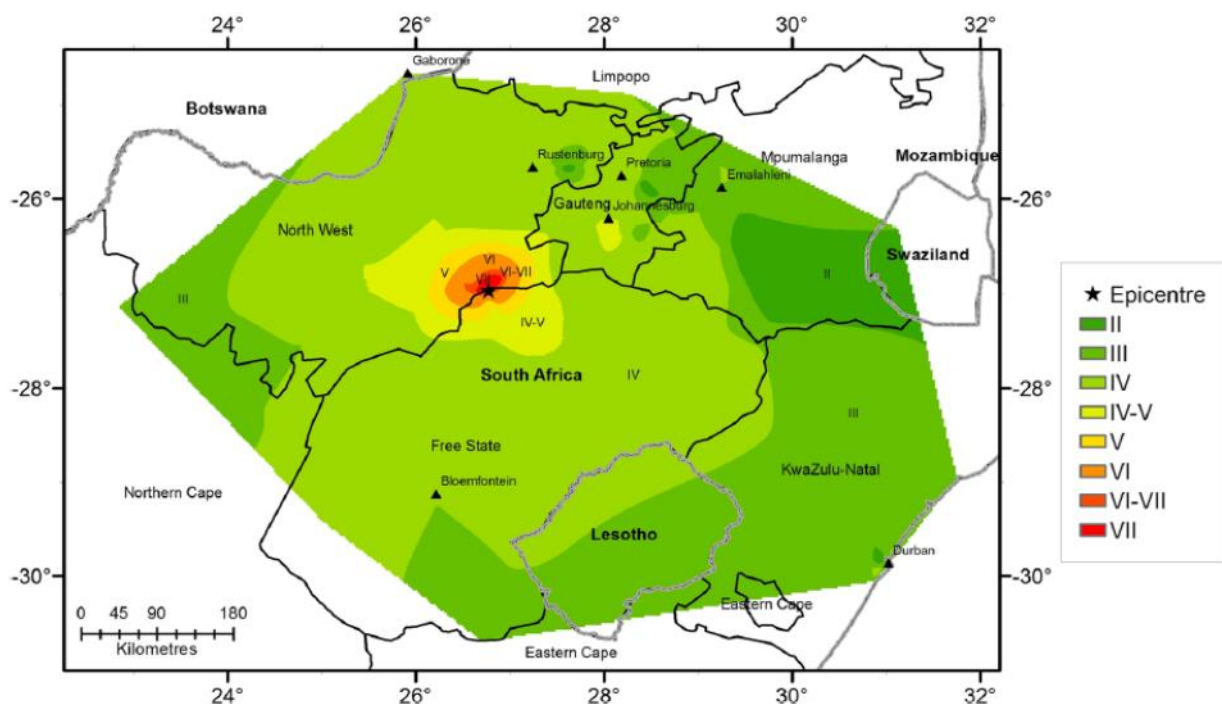
wezemfazwe zomhlaba, ingqalelo igxile kuphela ekuvukeni komhlaba okubangelwa yimfazwe zemvelo ezivela kwimithombo ye-tectonic. Ukunyakaza komhlaba okuvela kwimfazwe ezinxulumene nemigodi kuncitshiswa ngokukhawuleza ngokukhawuleza xa kuqhathaniswa nezo ezivela kwimfazwe ze-tectonic (ngenxa yomxholo omkhulu wemvamisa yokunyakaza kunye nobunzulu obuphantsi bezechleliso), ngoko ke olu tshintsho alulindelekanga ukuba lukhiqize ukunyakaza komhlaba okubalulekileyo kwezobunjinieli ngaphandle kwindawo ekufutshane nomthombo. Ngokufana neearhente ze-seismology kwi-hlabathi liphela, iziganeko eziveliswe ngabantu ngokukodwa ezifana neziganeko eziveliswe kukumba zihlala ziqwalaselwa yiKhomishini yeGeoscience (CGS) njengamanye amanyathelo abo okuqwalasela nokurekhoda umsebenzi we-seismic. Ngenxa yobukhulu kunye nendima yokumba eMzantsi Afrika, i-CGS ikwakhona ngokuqhelileyo ukuqwalasela nokwahlula iziganeko ezinxulumene nokumba. Iziganeko ezinxulumene nokumba ziqwalaselwa ngokusekelwe kwindawo yokuba zenzeka kuyo kunye nomfanekiso we-waveform njengamacandelo okuqwalasela idatha ye-seismic kwi-CGS kwaye ziboniswa ngokusebenzisa ubunzulu obahlukeneyo kwiimeko ze-tectonic, ngoko ke kulula ukuzisusa. Ukuba i-magnitude ingaphezulu kwe-ML = 3.0, ininzi yeziganeko eziya kulahleka. Qaphela ukuba ukuvela kweziganeko ezinamandla aphakathi kwezokuqulunqwa kukumba kudibene kakhulu nemisebenzi yokumba enzulu (ugolide kunye nemigodi yetayitile), ehlanganiswe kumazantsi kunye neziko lelizwe, kwaye ngaphezulu kwayo ayikho kwindawo yokufunda yaseThyspunt.

Isizathu sokususa iziganeko ezenziwe ngabantu (ezenziwe ngumntu) kwi-catalogue yeentlekele zomhlaba sasineenjongo ezimbini: okokuqala, ezi ziganeko zilandela iipateni ezahlukeneyo zexesha kuba zibangelwa ziinkqubo ezahlukeneyo kwiinkqubo zetektonikhi ezikhokelela kwi-seismicity yendalo. Ngenxa yoko, ukongeza ezi ziganeko kumzekelo womthombo we-seismic kuya kusafuneka ukuba zikhankanywe kwaye zahlulwe, kwaye emva koko kudityaniswe ubudlelwane bokuphinda kwenzeke oku ngokukodwa malunga nalezi ziganeko. Inqanaba lesibini kwisizathu sokuxosha ezi ziganeko kwi-catalogue kunye nophuhliso lwemodeli yomthombo we-seismic kukuba zibhekisela kwimixube yobukhulu kunye nemigama engabalulekanga ekuvavanyeni umngcipheko we-seismic kwindawo yaseThyspunt. Ukuba bekukho imithombo yeentlekele zomhlaba ezinxulumene nemigodi esondele kakhulu kwindawo, ngoko bekuya kufuneka kubandakanywe inaleli galelo ekubeni yimfuneko ukuphuhlisa iimeko zemithombo ye-seismic zolu hlobo lwentlekele ezenziwe ngabantu. Nangona kunjalo, indawo yaseThyspunt ikude kakhulu kwiindawo zokumbiwa kwegolide, kwaye luhlobo lwezimfazwe ezinjalo ukuba zithinteleke kwimimandla esekufutshane nomsebenzi wabantu, kule meko ukumbiwa kwegolide okwenzekayo nzulu. Njengoko iziganeko ezinkulu kakhulu ezinokubakho ezinxulumene nokumbiwa kwegolide zilinganiselwe ukuba ziphantsi kancinci kakhulu komda ophantsi wombulelo wokungcangcazela ongama-M 5 ocebise kwi-PHSA (ngokuhambelana ne-USNRC Regulatory Guide 1.208), ezi ziganeko aziniki nto kwisangqa somngcipheko wendawo.

Makhe sijonge kwinqanaba le-ML 5.5 lomhlaba ngo-5 Agasti 2014 kufutshane ne-Orkney (elithathwa njengelinxulumene nenkunkuma yezemigodi). Olu luphahlazo lomhlaba,

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olwalunxulumene nemigodi, indawo lude ngaphezu kwe-800 km ukusuka kwisiza saseThyspunt. Kuyacaca ukuba ukuphahlazwa komhlaba onamandla e-5.5 kumgama ongaphezulu kwe-800 km ukusuka kwisiza bekungayi kuba nefuthe nakancinci kwiingozi zokudutshulwa emhlabeni eThyspunt. Oku kuqinisekisiwe ziimveliso zokuphakama ezivela kulo mphahlazo womhlaba ezibonisa ukuba kummda wezantsi-mpuma we-Free State—okumgama ongaphezulu kwe-400 km ukusuka eThyspunt—amandla sele ehle kuye kwi-III okanye kwi-II (Umfanekiso 20), okokugqibela kwezi zimbini kungumda ophantsi opheleleyo wokubona komntu okwezemfezeko okungqongweyo kwaye ekuphumleni evakalisa ukuhuzuka komhlaba.



Umfanekiso 20: Imephu ye-Iseseismal yokuQhakaza komhlaba kwango-2014 e-Orkney [64]

Ngoko ke, iziganeko ezibangelwa yimigodi zinokupholiswa kwikhatologu kuba aziveli kumthombo we-tectonic kwaye azinikeli nto iphantsi kokulinganiselwa komngcipheko, ngenxa nje yokwahluka kwazo kwindawo.

5.3.2.2.2 Ukucima umphezulu

Amathuba okuba kubekho iimpazamo kumphezulu (oko kukuthi, amandla okuba kubekho iimpazamo) ahlolwe kwindawo leyo. Iindlela ezisetyenzisiweyo kunye nophando olwenziweyo zazineenkukacha ezaneleyo ukuze kuqinisekisiwe ukuba akukho mpazamo inokwenzeka kwindawo leyo. Uphando lubonisa ukuba akukho bungqina bokuba kubekho iimpazamo ze-tectonic kwindawo leyo kwaye amathuba okuba kubekho iimpazamo ze-tectonic awanamsebenzi. Oku kusekelwe kuphando lwejoloji olubonise ukuba iimpazamo ezikwimephu kwindawo leyo azinazo iimpazamo ezinokwenzeka. Imephu ye-Bedrock kwindawo ekufutshane nendawo leyo ayifumananga bungqina bokuba kukho iimpazamo kumphezulu okanye iimpazamo ezinokuthi zibonise iimpazamo ezinokwenzeka kwindawo leyo. Isiseko sesi

sigqibo kukungabikho kweempawu ze-geomorphic, ezibonisa ukuguquguquka kwe-Quaternary.

5.3.2.3 Iziganeko Zemoyozulu

Iimpawu zemozulu nezemozulu zommandla ojikeleze indawo ziphandwe zaza zavavanywa ukuxhasa ukuchongwa kweziganeko zangaphandle kunye neengozi ezinokubakho ekufakweni kwenyukliya kwindawo leyo. Ulwakhiwo lomoya olufunekayo ukuze kuvunyelwe ukuqikelela ukusasazeka komoya okufunekayo ukuze kuvavanywe impembelelo enokubakho yeradiyoloji kuluntu nakwindalo esingqongileyo kwaye kuphuhliswa nokwenzeka kokucwangciswa kwengxakeko. Ngokuhambelana neengcebiso zasekhaya nezamazwe ngamazwe, iintlobo ezimbini eziphambili zeziganeko zemozulu kunye neziganeko kufuneka zivavanywe kwinqanaba lovavanyo lwendawo, oko kukuthi, amaxabiso agqithisileyo eeparamitha zengozi yemozulu kunye neziganeko ezingaqhelekanga zemozulu.

Ukuze kuvavanywe amaxabiso azo agqithisileyo anokubakho, kuphandwe ezi ziganeko zilandelayo zemozulu: umoya onamandla enkanyamba (kubandakanya izivuthuvuthu zothuli oluvuthuzwa ngumoya), iindudumo, imvula (kubandakanya isichotho), ubushushu bomoya (ibhalbhu eyomileyo kunye nebhalbhu emanzi), uxinzelelo lomoya, kunye nokunyuka kwesichotho. Ukungaqiniseki kwidatha kunye nemiphumo enokubakho yotshintsho lwemozulu kuthathelwe ingqalelo kolu vavanyo.

5.3.2.3.1 Umlinganiselo wemozulu

Idatha yemozulu kwindawo iqokelelwe ixesha leminyaka esixhenxe kuphela. Idatha eqokelelwe kwixesha elide iyafuneka ukuze kuhlalutywe izibalo ixesha elide. Ukuze kuvunyelwe ukusekwa kweendlela zembali, i-NNR kunye ne-IAEA zikubona kwamkelekile ukuqokelela ulwazi lwemozulu kwizikhululo zemozulu ezikufutshane. Ekubeni iimeko zaseCape St. Francis zimela kakhulu iimeko zemozulu kwindawo leyo, idatha yendawo yongezwe yidatha yemozulu yexesha elide eqokelelwe sisikhululo semozulu seSouth African Weather Service (SAWS) eCape St. Francis (34°12'40"S 24°50'02"E), malunga ne-9.3 km empuma-mpuma-mpuma yendawo kwindawo ephakamileyo ye-9 m ngaphezu komgangatho wolwandle ophakathi (m amsl) (Umfanekiso 21) Umfanekiso 19. Ukongeza kwimibono yemozulu eCape St. Francis WS, idatha yemvula yexesha elide ifunyenwe kwiHumansdorp WS, malunga ne-17.3 km emantla-mpuma yendawo (34°02'16.80"S 24°45'39.60"E kunye ne-109 m amsl). Nangona ikude kakhulu nendawo, isikhululo semozulu esizenzekelayo ngokupheleleyo esinembali ende yedatha sikwiGqeberha, malunga ne-85 km empuma-mpuma-mpuma yendawo (34°59'10"S 25°36'58"E kunye ne-60 m amsl).

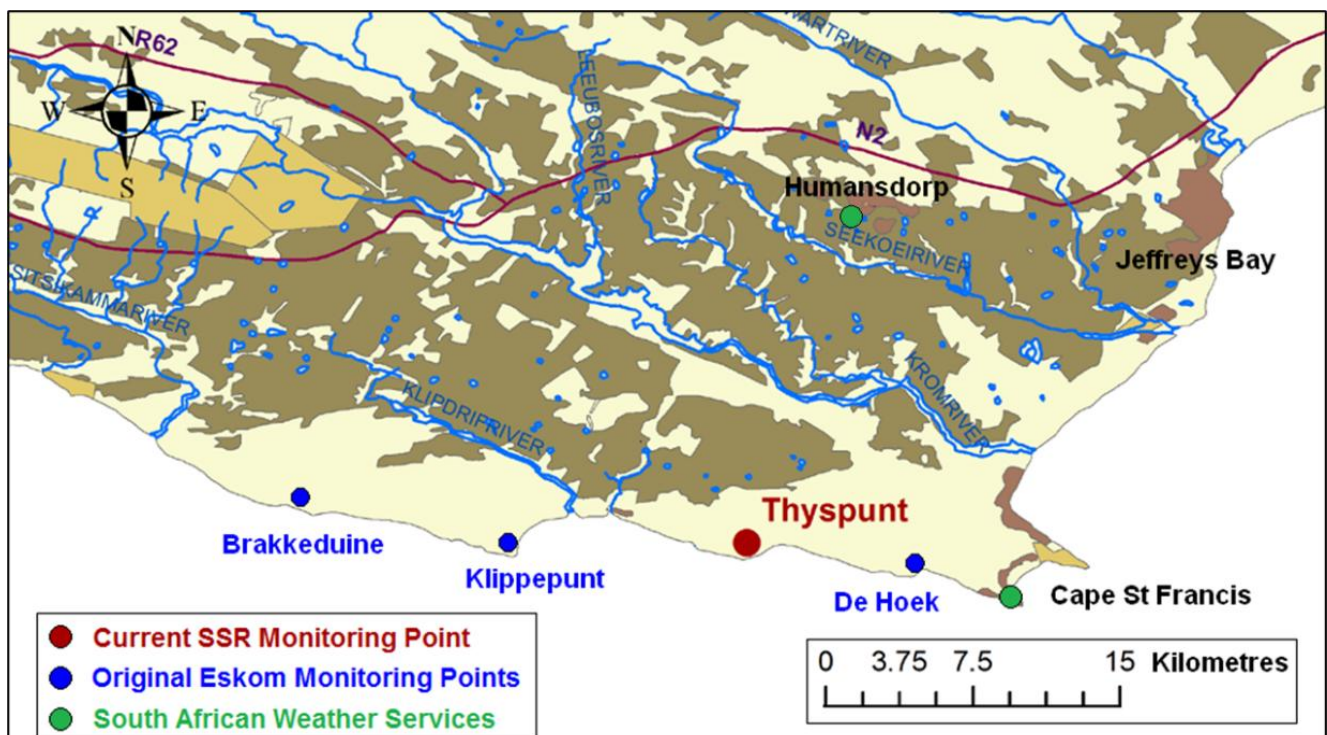
Isikhululo semozulu esikwindawo sikwi-34°11' 3.19"S 24°42' 31.50"E kunye nokuphakama kwe-51 m amsl, okumalunga ne-730 m entshona yendawo yangoku (34°10' 60.00"S 24°43' 0.00"E kunye ne-28 m amsl) kwaye malunga ne-760 m ukusuka kuphawu lokuphakama kwamanzi. Iparameter ezilinganisiweyo kwesi sikhululo semozulu ziquka isantya somoya kunye necala elikwi-9 m ngaphezu komhlaba, ubushushu bebhalbhu eyomileyo kwi-2 m kunye ne-8 m ngaphezu komhlaba, imitha yelanga, ukufuma okufanelekileyo, uxinzelelo lomoya, imvula, ukubonakala kunye neziganeko zombane.

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I-data logger ezenzekelayo isetyenziselwa ukurekhoda idatha yemozulu. Idatha igcinwa njenge-avareji yemizuzu eli-10 kwifomathi ye-elektroniki. Idatha ifunyanwa kude ngemodem yocingo okanye ikhutshelwe kwindawo, kusetyenziswa intambo yoqhagamshelo lokudlulisa idatha kunye nekhompyutha yomntu.

Ukugqwala komoya wendawo kulinganiswe kusetyenziswa indlela ye-ISO Standard. Indlela ye-ISO Standard 9223 [12] isebenzisa ubushushu obulinganisiweyo kunye nokufuma okunxulumeneyo kwisikhululo semozulu sendawo kunye nesantya sokufakwa kwe-sulphur dioxide kunye netyuwa emoyeni ukumisela izinga lokugqwala.

Ukulinganiswa kwemozulu kumanqanaba aphezulu kuya kuqaliswa ubuncinane unyaka omnye ngaphambi kokuqala kokwakhiwa kokufakwa kwenyukliya.



Umfanekiso 21: Iindawo ze-Eskom Historical Monitoring Points, i-SAWS WS kunye ne-Thyspunt WS

5.3.2.3.2 liparamitha Zemozulu

i) Isantya somoya kunye necala oya kulo

Ukusasazeka komoya emoyeni okhutshwa kwindawo ethile ikakhulu kuxhomekeke kwisantya somoya kunye necala lawo. Isantya somoya sichaphazela umgama wokuhamba uye ezantsi kunye nesantya sokuxuba. Ukuveliswa koxinzelelo loomatshini ngokufanayo kuxhomekeke kwisantya somoya, kwaye icala lomoya limisela indlela yokuqhubela phambili [10].

Isantya somoya kunye nokuqwalaselwa kwendlela okwenziwe ngayo phakathi kuka-2008 no-2013 no-2017 no-2019 kwisikhululo semozulu se-SAWS eCape St. Francis kunye nesikhululo semozulu saseThyspunt esikwindawo, kubonisa ngokucacileyo ukuxhaphaka kweendlela zomoya wasentshona nasempuma kwiintyatyambo zomoya (jonga Umfanekiso 22). Indlela yomoya wasempuma-ntshona icaca ngakumbi kwisikhululo semozulu saseCape St. Francis, kunakwisikhululo semozulu saseThyspunt. Ngaphezu koko, isantya somoya esiphezulu kwisikhululo semozulu saseCape St. Francis siphezulu kancinci kunesikhululo semozulu saseThyspunt, oko kukuthi, i-23.2 m/s xa ithelekiswa ne-22.8 m/s kwixesha lika-2008 – 2013, kunye ne-20.6 m/s xa ithelekiswa ne-19.2 m/s kwixesha lika-2017 – 2019.

Lilonke, imimoya eqhelekileyo yasehlotyeni yayivela entshona nge-20.34% kwisikhululo semozulu saseThyspunt kunye ne-30.67% kwiCape St. Francis. Imimoya yesibini exhaphakileyo ehlotyeni yayivela empuma nge-13.12% kwisikhululo semozulu saseThyspunt kunye ne-22.11% kwiCape St. Francis.

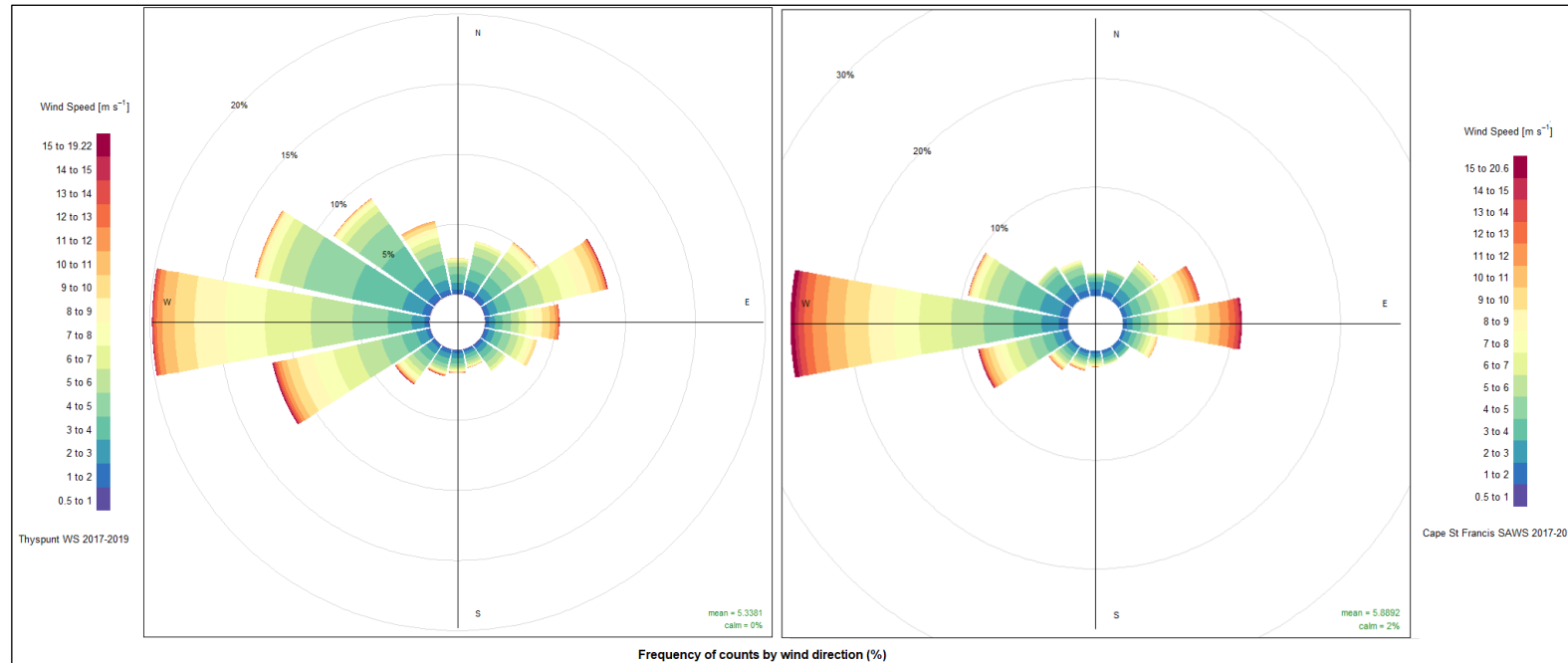
Imimoya yasebusika yayixhaphake kakhulu entshona nge-19.63% kwisikhululo semozulu saseThyspunt kunye ne-31.52% kwiCape St. Francis.

Lilonke, imimoya eqhelekileyo yasehlotyeni yayivela entshona nge-19.63% kwisikhululo semozulu saseThyspunt kunye ne-31.52% kwiCape St. Francis. Imimoya yasentwasahlobo yayixhaphake kakhulu ukusuka entshona nge-21.89% kwisikhululo semozulu saseThyspunt kunye ne-31.58% kwiCape St. Francis.

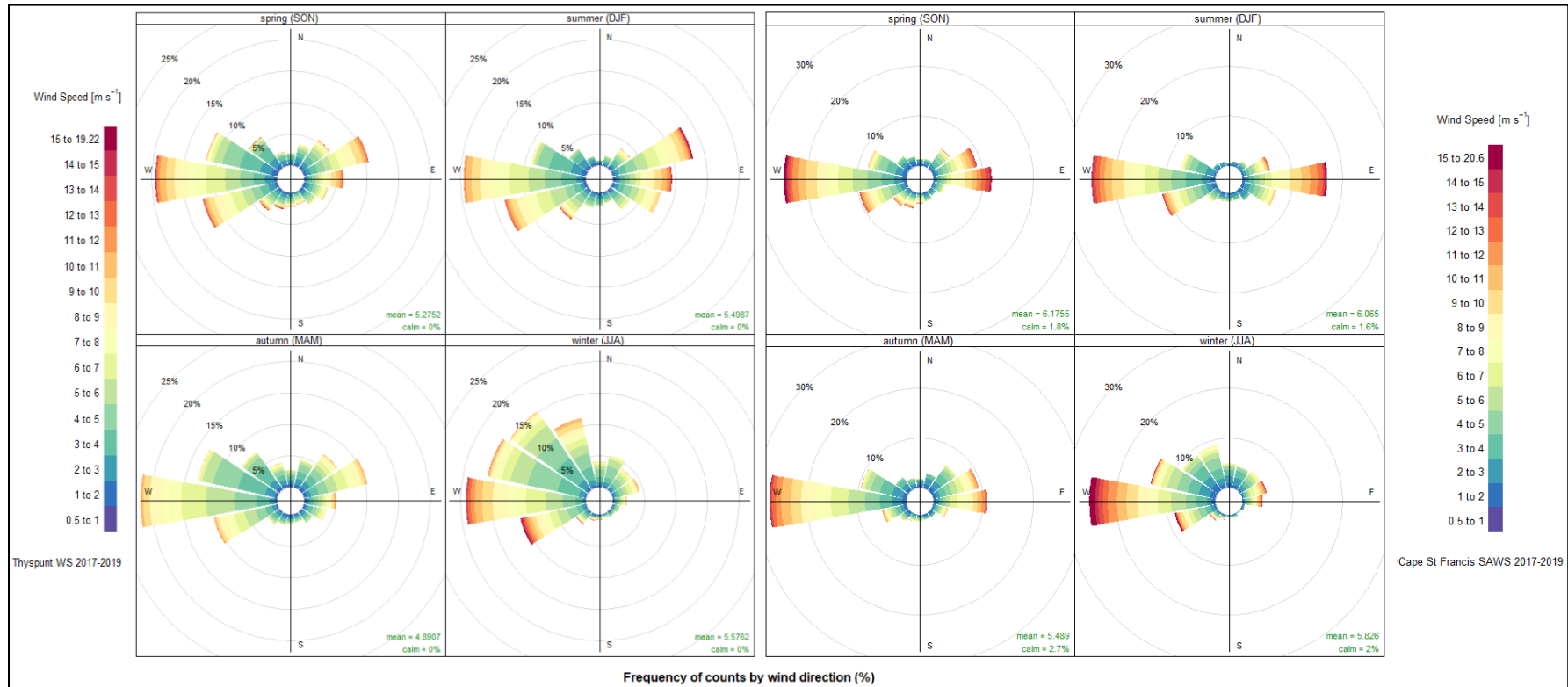
Imimoya yasekwindla yayixhaphake kakhulu ukusuka entshona nge-21.94% kwisikhululo semozulu saseThyspunt kunye ne-35.87% kwiCape St. Francis (jonga Umfanekiso 23).

Umyinge ophezulu weyure kunye neemvuthuvuthu zomoya ezirekhodiweyo kwindawo ngexesha lika-2008 - 2013 kunye no-2017 - 2019 ziboniswe kwi-Umfanekiso 23

ngezantsi. Imvuthuvuthu ephezulu erekhodiweyo kwiThyspunt WS yayiyi-32.2 m/s (nge-24 kaSeptemba 2019 ngentsimbi ye-7h00)). Imvuthuvuthu ephezulu eCape St. Francis WS ngaloo mini kunye neyure yayiyi-34.0 m/s. Umoya ophezulu kwiCape St. Francis WS wawuphezulu kakhulu, oko kukuthi, i-45.8 m/s (nge-18 ka-Agasti 2020 ngentsimbi ye-13h15). Ngelishwa, oku bekungaphandle kwephulo lokubeka iliso kwi-Thyspunt WS ukuze kutholekise.



Umfanekiso 22: Uthelekiso lwe-SAWS Cape St. Francis WS kunye ne-Thyspunt WS kwixesha lika-2017-2019



Umfanekiso 23: Uthelekiso lweeRoses zomoya zexesha lonyaka zeCape St. Francis WS kunye neThyspunt WS (2017 ukuya ku-2019)

Ittheyibhile 4: Umyinge ophezulu weNyanga ngeyure kunye neeMvuthuvuthu zomoya (m/s) kwizikhululo zemozulu zaseCape St. Francis naseThyspunt

Inyanga	Isikhululo seMozulu saseCape St. Francis		Isikhululo seMozulu saseThyspunt	
	2004 – 2023		2008 – 2013 & 2017 - 2019	
	Umyinge weYure ephezulu	Umoya Ophezulu	Umyinge ephezulu weYure	Umoya Ophezulu
EyomQungu	18.8	34.5	16.6	29.0
EyomDumba	16.6	35.7	14.8	30.7
EyoKwindla	19.5	31.2	14.7	24.1
EkaTshazimpuzi	18.1	28.7	14.1	31.6
ekaCanzibe	22.8	39.7	15.1	31.6
EyesiLimela	23.2	32.6	17.9	30.2
EyeKhala	21.2	37.9	19.3	32.2
EyeThupha	21.1	45.8	16.4	29.2
EyoMsintsi	18.8	31.6	17.9	37.9
EyeDwarha	19.3	38.5	17.9	31.7
EyeNkanga	17.5	30.2	15.5	25.5
EyoMnga	19.7	34.1	16.6	24.2
Yonyaka	23.2	45.8	19.3	37.9

ii) Ubushushu bomoya obungqongileyo

Ubushushu yiparameter ephambili yemozulu esetyenziswa njengesalathisi semeko yamandla okusingqongileyo.

Ukuphakama kwesalathiso sokulinganisa ubushushu obujikeleze umhlaba ngokuqhelekileyo yi-2 m ngaphezu komgangatho womhlaba. Amanqanaba okujonga ubushushu bomoya eThyspunt ekuqaleni ayekwi-2 m kuphela (2009-2013), kodwa ukususela ngo-2017 ukuya ku-2019 kwasekwa isenzi sesibini sobushushu kwi-8 m. Isenzi seqondo lobushushu kwisikhululo semozulu saseCape St. Francis sikwi-2 m ngaphezu komgangatho womhlaba.

Ukujonga ubushushu bomoya obuphantsi kwiThyspunt WS (ngoJanuwari 2008 ukuya ku-Okthobha 2013 nangoJuni 2017 ukuya kuSeptemba 2019) kubhale oku kulandelayo:

- umyinge wobukhulu bemihla ngemihla: 20.8 °C (umyinge we-ADMxT yenyanga kwiTheyibhile 5);
- umyinge wobuncinci bemihla ngemihla: 14.4 °C (umyinge we-ADMnT yenyanga kwiltheyibhile 5);
- iinyanga ezinobushushu obuphezulu bemihla ngemihla obuyi-23.4 °C nguJanuwari noFebruwari (ubukhulu benyanga obuyi-ADMxT kwiltheyibhile 5);
- inyanga enobushushu obuphantsi bemihla ngemihla obuyi-18.4 °C ngu-Agasti (ubukhulu benyanga obuyi-ADMxT kwiltheyibhile 5)
- inyanga enobushushu obuphantsi bemihla ngemihla obuyi-17.8 °C yiTheyibhile 5kaJanuwari
- inyanga enobushushu obuphantsi bemihla ngemihla obuyi-11.2 °C ngu-Agasti (ubukhulu benyanga obuyi-ADMnT kwiTheyibhile 5)
- ubushushu obuphakathi bonyaka buyi-17.3 °C (umndilili wobushushu obuqhelekileyo ngeyure).

Amaqondo obushushu aphantsi naphezulu ngeyure arekhodwe kwiThyspunt WS (inqanaba le-2 m) yayingama-6.7 °C (Agasti) kunye nama-38.2 °C (EkaTshazimpuzii). Amaqondo obushushu agqithisileyo ngeyure kwiCape St. Francis WS (inqanaba le-2 m) yayingama-4.9 °C (21 Juni 2018) kunye nama-38.5 °C (28 Matshi 2022).

Ittheyibhile 5: Ubushushu bebhahlu yomoya owomileyo [°C] kwi-Thyspunt WS (EyomQungu 2008 ukuya kwi-EyeDwarha 2013 kunye ne-EyesiLimela 2017 ukuya kwi-EyoMsintsi 2019)

Inyanga	Umdilili Wemihla ngemihla		I-95% yoMgangatho woQiniseko woMndilili	I-Median yemihla ngemihla	Iipesenti		Ubuninzi kunye nobuncinci						A#DDMxT		A#DDMnT	
	ADT	StdDev			25%	75%	MnADT	MxADT	TMn	TMx	ADMnT	ADMxT	>35.0	>30.0	<10.0	<5.0
1	20.5	1.3	±2.58	20.4	18.9	22.0	16.8	24.3	13.0	31.3	17.8	23.4	0.0	0.3	0.0	0.0
2	20.4	1.6	±3.04	20.3	18.7	21.8	16.0	26.4	13.5	32.4	17.6	23.4	0.0	0.9	0.0	0.0
3	19.8	1.7	±3.26	19.6	18.2	21.1	15.0	25.2	11.7	36.6	17.1	23.0	0.0	1.0	0.0	0.0
4	17.8	2.2	±4.35	17.7	15.8	19.4	11.7	25.3	8.3	38.2	14.8	21.3	0.3	0.9	0.1	0.0
5	17.0	2.4	±4.62	16.7	14.8	18.5	12.0	27.2	8.4	35.8	13.9	20.9	0.1	1.0	0.9	0.0
6	15.2	2.5	±4.98	14.8	12.7	16.9	10.0	24.7	7.1	31.2	11.8	19.1	0.0	0.4	5.1	0.0
7	15.1	3.0	±5.86	14.5	12.3	17.0	9.8	25.9	7.2	31.8	11.7	19.1	0.0	0.5	6.8	0.0
8	14.6	2.2	±4.35	14.3	12.3	16.4	9.8	22.6	6.7	31.3	11.2	18.4	0.0	0.3	8.3	0.0
9	15.4	2.2	±4.23	15.3	13.3	17.1	10.8	28.7	7.6	36.3	12.2	18.8	0.1	0.6	2.9	0.0
10	16.5	2.0	±3.98	16.2	14.7	17.9	12.9	25.9	9.4	34.7	13.6	19.5	0.0	0.7	0.4	0.0
11	17.3	1.6	±3.08	17.3	15.7	18.9	13.1	23.4	9.6	32.9	14.5	20.3	0.0	0.4	0.1	0.0
12	19.3	1.7	±3.30	19.1	17.6	20.9	15.7	23.6	11.2	34.0	16.5	22.1	0.0	0.3	0.0	0.0

ADT - Ubushushu obuqhelekileyo bemihla ngemihla: umyinge wamaqondo obushushu abonwa ngamaxesha angama-24 alinganayo kwixesha eliqhubekayo leeyure ezingama-24 (ezinzulwini zobusuku ukuya ezinzulwini zobusuku).

StdDev – Standard deviation.

MnADT - Ubuncinane bobushushu obuqhelekileyo bemihla ngemihla inyanga: ubuncinci bobushushu obuqhelekileyo bemihla ngemihla.

MxADT - Ubushushu obuphezulu obuqhelekileyo bemihla ngemihla inyanga: ubushushu obuphezulu obuqhelekileyo bemihla ngemihla.

TMn - Ubuncinane bobushushu ngeyure: ubuncinci bobushushu obubonwa ngamaxesha angama-24 alinganayo kwixesha eliqhubekayo leeyure ezingama-24.

TMx - Ubushushu obuphezulu ngeyure: ubushushu obuphezulu obubonwa ngamaxesha angama-24 alinganayo kwixesha eliqhubekayo leeyure ezingama-24.

ADMxT - Ubushushu obuphakathi obuphezulu bemihla ngemihla ngenyanga: umyinge wobushushu obuphezulu bemihla ngemihla.

ADMnT - Ubushushu obuphakathi obuphantsi bemihla ngemihla ngenyanga: umyinge wobushushu obuphantsi bemihla ngemihla.

A#DDMxT - inani eliqhelekileyo leentsuku ezinobushushu obuphezulu ngeyure obungaphezulu.

A#DDMnT - inani eliqhelekileyo leentsuku ezinobushushu obuphantsi ngeyure nganye.

iii) Ukuna kwemvula

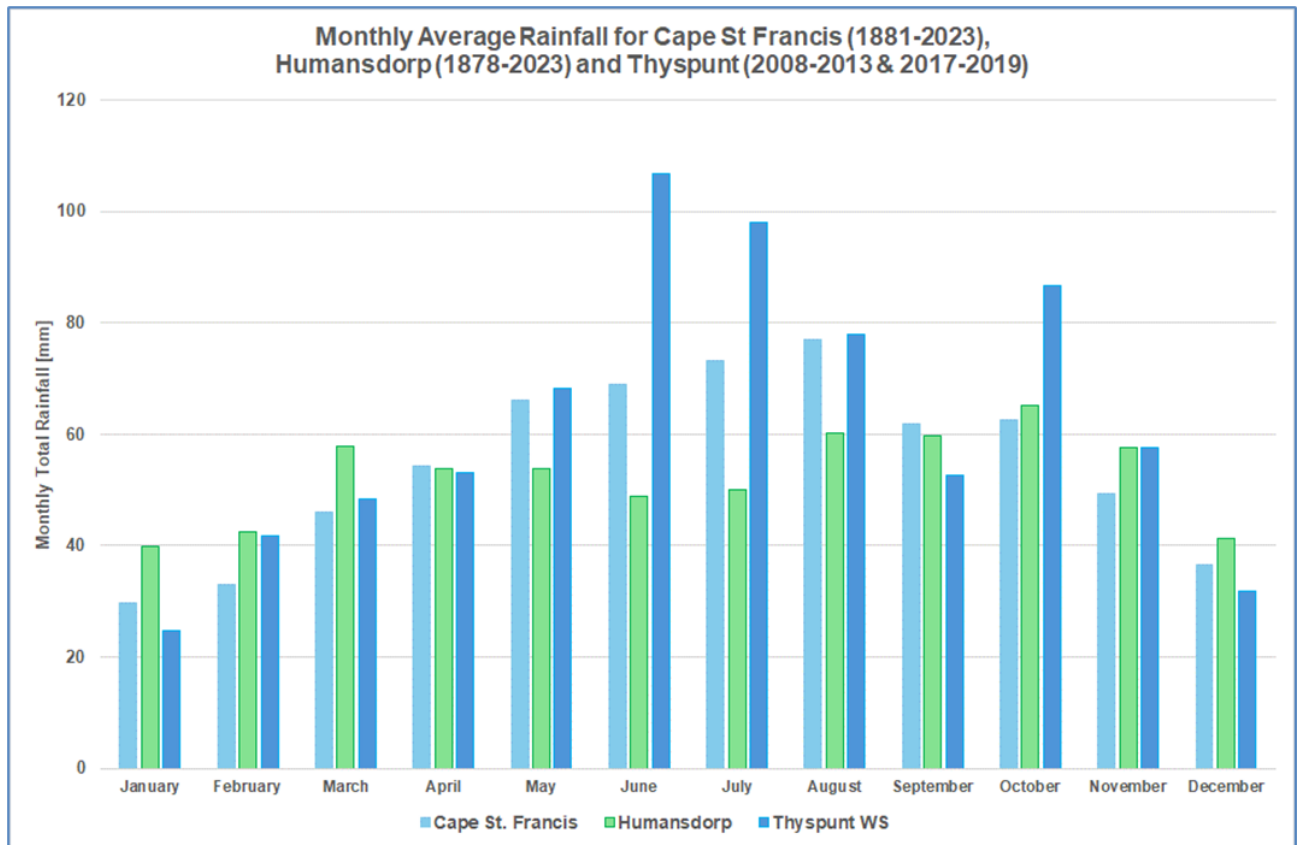
Iintlobo zemvula ziquka isichotho, iqhwa, ikhephu, imvula, kunye nokuphola. Ukwakheka kwemvula kunokubakho kumaqondo obushushu angaphezulu okanye angaphantsi kweqhwa. Ekubeni ukulinganiswa kwemvula kwenziwa ngokuzenzekelayo, okwangoku akunakwenzeka ukumisela iinkcukacha zohlobo lwemvula. Endaweni yoko, uhlobo lwemvula oluhlala luhleli ('iimvula') oluqheleke kakhulu kuloo ndawo lusetyenziswa ukuvavanya impembelelo yemvula kumaqondo omoya ongcoliseko kunye nongcoliseko lomhlaba.

Akukho rekhodi zifunyenweyo ezilinganisela ukwenzeka kwemvula ebandayo kwindawo. Nangona kunjalo, ngenxa yobushushu obuphezulu obumanzi obubhalwe kwindawo (obuphantsi kakhulu yi-3.5°C kwiThyspunt WS kunye ne-3.1°C kwiCape St. Francis WS), amathuba emvula ebandayo kulindeleke ukuba abe phantsi.

Indawo ifumana imvula unyaka wonke kunye neenyanga ezimanzi rhoqo ukusuka ku-Epreli ukuya kuNovemba kunye neenyanga ezomileyo ukusuka ngoDisemba ukuya kuMatshi. Ukongeza idatha yokubeka esweni kwindawo, isalathiso kunye nothelekiso kwezinye izikhululo zemozulu ezikufutshane kuyimfuneko. Idatha ye-Thyspunt WS ibandakanya iminyaka emithandathu ephelileyo ukusuka ngo-2008 ukuya ku-2012 (u-2013 awungonyaka ophelileyo) kunye no-2018 (u-2017 no-2019 awungonyaka ophelileyo). I-MAP yale xesha ibalwe ukuba yi-774.4 mm, engaphezulu kune-MAP ebonwe kwi-Cape St. Francis WS kunye ne-Humansdorp WS. Imvula engaphezulu komndilili yonyaka ibonwe ngo-2011 nango-2012 kwi-Thyspunt WS, nto leyo eyathi yajika umndilili kwixesha elo.

Ngokusekelwe kwiminyaka eyi-146 yokuqwalaselwa kwi-SAWS Humansdorp WS (1878-2022), i-MAP iqikelelwa ukuba yi-678.8 mm. Nangona kunjalo, le ndawo imalunga ne-17.3 km ngaphakathi kwelizwe ukusuka e-Thyspunt kwaye isenokungabonakalisi iimeko zemvula ezifanayo.

I-Cape St. Francis WS ikufutshane ne-Thyspunt (malunga ne-9.3 km empuma); nangona kunjalo, le ndawo ikufutshane kakhulu nonxweme kwaye inokuchaphazeleka yile ndawo ikufutshane. Idatha yemvula edibeneyo yexesha eliphakathi kwe-1881 ukuya ku-2023 inika iMAP ye-619.5 mm. Iziphumo zemvula ephakathi, encinci kunye neyona iphezulu yenyanga eHumansdorp, eCape St. Francis naseThyspunt ziboniswe kwiltheyibhile 6. Ixabiso eliphakathi lemvula yenyanga kwezi zikhululo zemozulu zintathu likwaboniswa ngokwemizobo kuUmfanekiso 24



Umfanekiso 24: Idatha yeMvula yeNyanga eCape St. Francis WS, eHumansdorp WS naseThyspunt WS

Imvula eqhelekileyo yenyanga isasazeke kakuhle unyaka wonke nge:

- Umyinge ophezulu wenyanga we-106.7 mm kunye ne-98.0 mm ezenzeka ngoJuni nangoJulayi, ngokulandelelana;
- Umyinge ophantsi wenyanga we-24.8 mm ngoJanuwari.

Imvula ephezulu yenyanga ye-353.2 mm yenzeka ngoJulayi, kwaye imvula ephantsi yenyanga ye-0.5 mm yenzeka ngoMatshi.

Imvula ephezulu yeeyure ezingama-24 eCape St. Francis (isikhululo esidala) ye-130 mm yenzeka ngomhla wama-27 kuMeyi 1944. Imvula entsha ephezulu yeeyure ezingama-24 ye-157,8 mm yabhalwa ngomhla wesi-5 kuMatshi 2007 kwisikhululo esitsha seSAWS. Imvula ephezulu yeyure ebonwe kwiCape St. Francis WS yayiyi-37,4 mm (17 Disemba 2022). Imvula ephezulu ngeyure kwindawo eyi-51,9 mm yarekhodwa ngomhla we-17 kweyoKwindla ngo-2011.

Itheyibhile 6: Imvula ephakathi, ephezulu nephantsi yenyanga eCape St. Francis WS, Humansdorp WS kunye neThyspunt WS

Inyanga	Umndilili weNyanga [mm]				Eyona Nyanga Iphezulu [mm]				Eyona iphantsi ngenyanga [mm]			
	Cape St. Francis		Humansdorp	Thyspunt	Cape St. Francis		Humansdorp	Thyspunt	Cape St. Francis		Humansdorp	Thyspunt
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
EyomQungu	31.1	21.1	39.9	24.8	104	70.2	176.1	48.2	0.0	4.4	2.8	11.0
EyomDumba	34.1	25.7	42.5	41.8	188	49.4	217.0	77.3	3.0	7.4	1.8	18.6
EyoKwindla	45.6	49.2	57.9	48.4	257	173.4	250.3	169.7	1.0	0.4	1.4	0.5
EkaTshazimpuzi	55.5	46.3	53.7	53.2	173	104.4	193.3	101.3	1.0	8.2	2.3	7.9
ekaCanzibe	67.7	55.2	53.8	68.3	251	209.2	261.2	245.5	0.1	7.0	0.5	20.7
Eyesilimela	69.4	66.2	48.8	106.7	215	212.2	270.2	199.7	0.0	15.8	0.8	29.2
EyeKhala	72.3	78.8	50.0	98.0	198	224.2	238.3	353.2	6.0	2.4	4.9	10.8
EyeThupha	76.1	82.7	60.2	77.8	185	213.0	465.0	192.4	0.0	9.4	0.3	10.5
EyoMsintsi	64.7	43.7	59.8	52.6	366	121.2	341.5	122.4	3.4	11.2	6.0	1.1
EyeDwarha	64.2	52.5	65.1	86.8	209	167.6	487.7	208.6	7.0	8.4	2.4	34.4
EyeNkanga	50.4	41.5	57.7	57.6	188	117.2	263.5	121.6	1.0	3.8	4.8	23.4
EyoMnga	37.3	32.4	41.4	31.9	176	138.0	244.3	81.0	4.0	0.4	2.5	6.5
Average	55.7	49.6	52.6	62.3	209	150.0	284.0	160.1	2.2	6.6	2.5	14.6
Highest	76.1	82.7	65.1	106.7	366	224.2	487.7	353.2	7.0	15.8	6.0	34.4
Lowest	31.1	21.1	39.9	24.8	104	49.4	176.1	48.2	0.0	0.4	0.3	0.5

Notes:

- (1) (1) Iziphalo ziquka ukususela ngo-1881 ukuya ku-2003
- (2) (2) Iziphalo ziquka idatha ye-Eyesilimela ukususela ngo-2004 ukuya ku-EyoMnga ka-2023. Unyaka ongaphelanga ka-2004 (15 Eyesilimela ukuya ku-31 EyoMnga) kwaye emva koko zakhutshelwa ngaphandle.
- (3)
- (4) (3) Iziphalo ziquka idatha ye-Meyi 1878 ukuya ku-EyoMnga ka-2023.
- (5) (4) Iziphalo ziquka idatha ye-EyomQungu ukususela ngo-2008 ukuya ku-EyeDwarha ka-2013 kunye nedatha ye-Eyesilimela ukususela ngo-2017 ukuya ku-EyoMsintsi ka-2019. Unyaka ongaphelanga ka-2013 (1 EyomQungu ukuya ku-4 EyeDwarha). Unyaka ongaphelanga ka-2017 (16 Eyesilimela ukuya ku-31 EyoMnga) kunye no-2019 (1 EyomQungu ukuya ku-10 EyeDwarha).

iv) Imbalela kunye neminyaka yemvula

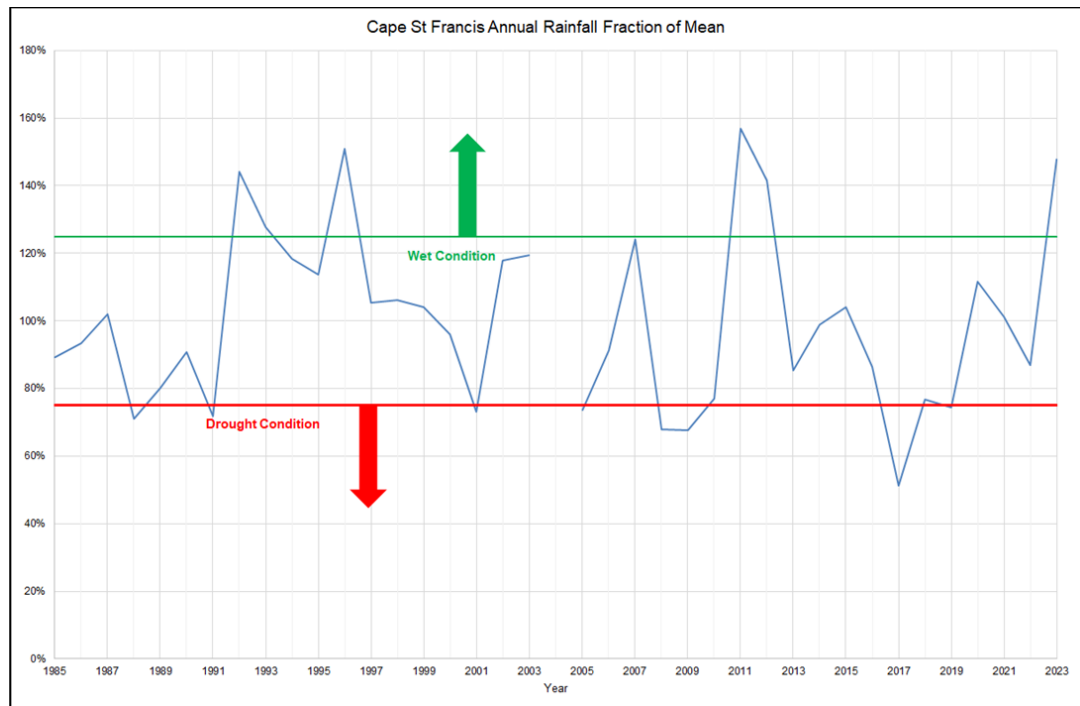
I-SAWS ichaza imbalela ngokusekelwe kwizalathisi ezimbini. Isalathisi sokuqala sisekelwe kwinqanaba lokoma xa kuthelakiswa nomlinganiselo wemvula eqhelekileyo okanye ephakathi kwindawo ethile okanye ixesha lonyaka owomileyo. Oku kubizwa ngokuba yimbalela yemozulu, kwaye unyaka oqhelekileyo uya kubalwa kwixesha leminyaka engama-30.

Ngaphantsi kwama-75 ekhulwini emvula eqhelekileyo ithathwa njengembalela yemozulu embi kodwa ama-80 ekhulwini emvula eqhelekileyo aya kubangela ukunqongophala kwezityalo namanzi. Unyaka onemvula unemvula engaphezulu ngama-25 ekhulwini kunonyaka oqhelekileyo (oko kukuthi, i-125 ekhulwini).

Imbalela kunye neminyaka emanzi njengoko kubonwe kwiCape St. Francis WS ngexesha le-1985 ukuya ku-2023 zibonelelwe kUmfanekiso 25. Ngeli xesha, iminyaka emithandathu emanzi (1992, 1993, 1996, 2011, 2012 kunye no-2023) kunye neminyaka esixhenxe yembalela (1988, 1991, 2001, 2005, 2008, 2009 kunye no-2017) yabonwa. Iminyaka emibini, u-2007 kunye no-2019 yayikwicala lokuba ngunyaka omanzi nowomileyo, ngokulandelelana. Ekubeni olu luhlu luthelakisa ukungabikho kwemvula kwinyanga yangoku kunye nemvula kwinyanga efanayo kwimbali yesikhululo kwaye alucingi ngesiphumo esidibeneyo sokungabikho kwemvula, iStandard Precipitation Index (SPI) yaziswa.

Ubalo lwe-SPI lusekelwe ekusasazweni kwemvula kwixesha elide (kungcono ngaphezu kweminyaka engama-50). Amaxabiso e-SPI angaphezulu kwe-zero abonisa amaxesha emvula kwaye amaxabiso angaphantsi kwe-0 abonisa amaxesha omileyo. Isiganeko embalela senzeka nanini na xa i-SPI isoloko ingekho semgangathweni kwaye ifikelela kubunzulu obuyi--1.0 okanye ngaphantsi.

Ngexesha leminyaka engama-39 yembali eCape St. Francis WS, iminyaka emihlanu "eyomileyo kakhulu" (1989, 2004, 2005, 2017 kunye no-2018) yabonwa ngeminyaka emibini "eyomileyo kakhulu" (1997 kunye no-2012).



Umfanekiso 25: Amaxesha emvula eyomileyo nemanzi aqatshelwe eCape St. Francis WS

v) Iindudumo, Isichotho, Ikhephu, kunye neNkungu

Idatha yemozulu ye-SAWS yaseCape St. Francis (1881-1984) yasetyenziswa ukumisela inani eliqhelekileyo leentsuku apho iindudumo, isichotho, ikhephu kunye nenkungu zenzeka khona. Iziphumo zohlalutyo lwedatha ziboniswe kwiTltheyibhile 7.

Ittheyibhile 7: Inani eliqhelekileyo leentsuku ezineendudumo, isichotho, ikhephu, kunye nenkungu eCape St. Francis (1881-1984)

Inyanga	Iindudumo	Isichotho	Ikhephu	Inkungu
EyomQungu	0,6	0,0	0,0	2,0
EyomDumba	0,7	0,0	0,0	4,0
EyoKwindla	1,0	0,0	0,0	4,8
EkaTshazimpuzi	0,8	0,0	0,0	2,8
Meyi	0,7	0,2	0,0	1,1
EyesiLimela	0,3	0,1	0,0	0,2
EyeKhala	0,3	0,2	0,0	0,5
EyeThupha	0,4	0,2	0,0	0,8
EyoMsintsi	0,5	0,0	0,0	1,0
EyeDwarha	0,8	0,1	0,0	2,4
EyeNkanga	0,6	0,0	0,0	2,1
EyoMnga	0,5	0,0	0,0	2,6
Ngonyaka	7,2	0,8	0,0	24,3

vi) Ukufuma komoya

Ukulinganiswa komswakama ohambelanayo kwenziwe ukususela ngoJanuwari 2008 ukuya ku-Okthobha 2013 kunye noJuni 2017 ukuya kuSeptemba 2019 kwiThyspunt WS.

Umswakama ohambelanayo wonyaka obhalisiweyo wawuyi-76.9 ekhulwini kwiThyspunt WS kunye ne-79.0 ekhulwini kwiCape St. Francis WS. Umswakama ohambelanayo wosuku ophezulu kwiThyspunt WS kunye neCape St. Francis WS wabhalwa ngoFebruwari kuzo zombini iindawo, oko kukuthi, i-83.5 ekhulwini kunye ne-84.1 ekhulwini, ngokwahlukeneyo. Amaxabiso aphezulu omswakama wosuku kwisikhululo saseCape St. Francis nawo enzeka ngoJanuwari nangoFebruwari, oko kukuthi, i-84,4 ekhulwini kunye ne-85,1 ekhulwini ngokwahlukeneyo.

Umswakama ohambelanayo wosuku ophantsi kwiThyspunt WS wawungoJulayi (66,9 ekhulwini) kwaye ngoJuni kwiCape St. Francis WS (72,6 ekhulwini). Umlinganiselo wonyaka ophezulu kunye nowobuncinci bokufuma oburekhodwe kwiThyspunt WS ubuyi-99.9 ekhulwini kunye ne-40.3 ekhulwini ngokwahlukeneyo.

Umlinganiselo wonyaka ophezulu kunye nowobuncinci bokufuma oburekhodwe kwisikhululo saseCape St. Francis ubuyi-97.5 ekhulwini kunye ne-46.1 ekhulwini ngokwahlukeneyo.

vii) Uzinzo lomoya

Iindawo ezisemazantsi nasentshona zonxweme zifumana ukuguquguquka okungapheliyo okuphantsi komhlaba, okubizwa ngokuba yi-sub-escarpment layer, enesiseko sayo esimalunga ne-500 m kunye nobunzulu obumalunga ne-600 m. Olu luhlu lubangelwa kubukho benkqubo ye-South Atlantic high-pressure (HP), kwaye lumele umda phakathi komoya ophezulu owomileyo, othobileyo kunye nokufutha komoya waselwandle. Ukuphakama ngaphezu komhlaba wolu luhlu kunxulumene nobukhulu benkqubo yomoya wolwandle kunye nobukhulu bokuguquguquka komoya ophezulu. Amandla okuguquguquka abonakalisiwe ukuba ayahluka phakathi komyinge we-7°C ehlotyeni kunye ne-5,2°C ebusika. Ukuguquguquka okungaphantsi komhlaba kunamandla kwaye kwenzeka rhoqo ehlotyeni (51%) ngenxa yokuba i-South Atlantic HP ifikelela kwindawo yayo yasempuma ngoDisemba.

Ngokusekelwe kwi-gradient yobushushu phakathi kwamanqanaba e-2 m kunye ne-8 m, kuqikelelwa ukuba ukuguquguquka komphezulu kwenzeka malunga ne-30% ngonyaka, kwaye okona kuxhaphake kakhulu kwiinyanga zasebusika. Njengoko bekulindelekile, iziganeko zasehlotyeni ziphantsi kakhulu ukusuka kwi-17 ekhulwini ngoDisemba ukuya kwi-18 ekhulwini ngoMatshi.

Kusetyenziswa indlela ye-sigma-theta ukubala uzinzo lomoya, imeko yomoya exhaphakileyo ebonwe kwi-Thyspunt WS ibonwe izinzile kancinci (udidi lozinzo E), ine-45.89 ekhulwini kunye ne-neutral (udidi lozinzo D) ene-40.67 ekhulwini. Indlela ye-sigma-theta ifanelekile ngakumbi kudidi lozinzo kwi-Thyspunt WS.

viii) Ukubola.

a) Imiphumo Erhabaxa Ebangelwa Yintlabathi Nothuli

Ekubeni imimoya enamandla ibonakala kwindawo leyo, iindawo ezinkulu ezinesanti ezibonakala zisenokwaphuka zinokuba sengozini yokukhula kothuli oluvuthuzwa ngumoya. Zenzeka xa amandla omoya edlula ixabiso eliphakathi apho isanti ekhululekileyo kunye nothuli zisuswa khona kwindawo eyomileyo zize zibe nomoya. Igama elithi 'isivuthuvuthu sothuli' lisetyenziswa kakhulu xa amasuntswana amancinci evuthuzwa kumgama omde, ngelixa igama elithi 'isivuthuvuthu sothuli' lisetyenziswa ngakumbi xa, ukongeza kumasuntswana amancinci afihla ukubonakala, inani elikhulu lamasuntswana amakhulu esanti evuthuzwa emoyeni kwaye ashukunyiswa, kodwa asondele kumphezulu. Izityalo ezifumaneka kwindawo leyo zisebenza njengeniyathelo lendalo lokunciphisa. Ukunyakaza kothuli kwenzeka kuphela kwisantya somoya esiphezulu kunexabiso eliphakathi kwaye akuxhomekeke ngokuthe ngqo kwingxolo yomoya kunye nesantya. Ngokwe-IAEA, ukuphindaphindeka kwezivuthuvuthu zothuli kunye nezivuthuvuthu zesanti kunokubonwa ngokuqwalasela imozulu ngeyure xa ukubonakala kukwiikhilomitha ezili-10 okanye ngaphantsi, isantya somoya sidlula ixabiso lomlinganiselo (oko kukuthi, i-7.5 m/s), kwaye ukufuma

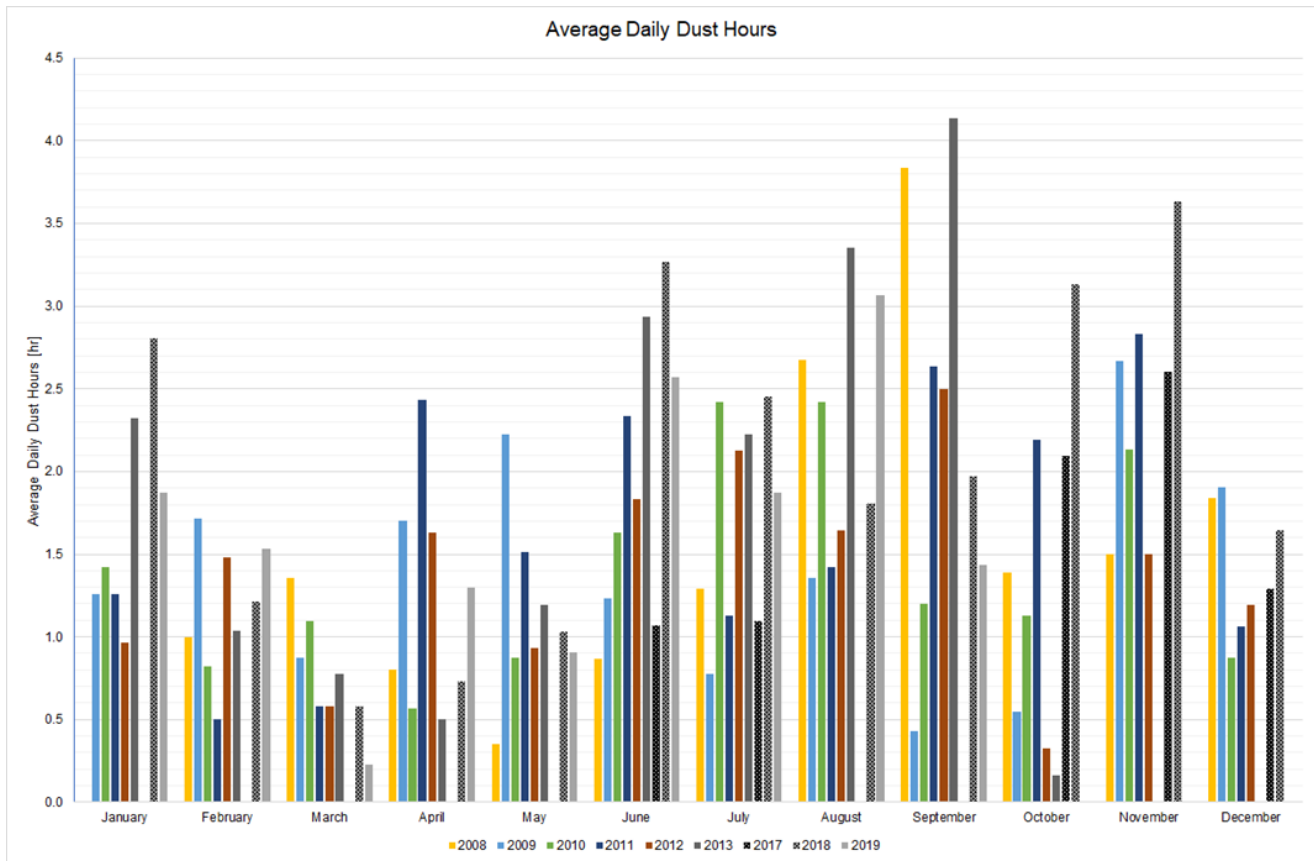
kungaphantsi kwexabiso lomlinganiselo (oko kukuthi, ngaphantsi kwama-70 ekhulwini).

Idatha yeThyspunt WS (ngoJanuwari 2008 ukuya kuSeptemba 2013 kunye noSeptemba 2017 ukuya kuMatshi 2019), ibonisa ukuba inani eliphezulu leeyure zothuli oluvuthuzwa ngumoya lwenzekile kwiinyanga zasehlotyeni, apho uNovemba wayeneziganeko eziphezulu. Limeko zothuli eziphantsi zenzeke ngoMatshi.

Umthwalo wothuli ophezulu ngexesha lokubeka esweni wenzeke ukususela ngentsimbi ye-01h00 ukuya kwintsimbi ye-21h00 ngomhla wama-27 ku-Agasti 2018. Ixesha lomthwalo wothuli oluhlanganisiweyo kweli xesha libalwe njenge-22.3 mg-h/m³. Isantya somoya esiqhelekileyo kwixesha leeyure ezingama-21 yayiyi-9.6 m/s esenzeka ukusuka kumzantsi-ntshona kunye neemvuthuvuthu eziphezulu ukuya kuthi ga kwi-22.8.

Nksk.Ngokusekelwe kwiziganeko zothuli ezibonwayo (Umfanekiso 26), uJuni, uOkthobha kunye noNovemba zezona nyanga zinokwenzeka kakhulu ukuba zibe nezivuthuvuthu zothuli, ngelixa uMatshi, uEpreli kunye noMeyi zezona nyanga zinokwenzeka kancinci ukuba zibe nezivuthuvuthu zothuli. Kusenokwenzeka ukuba ixesha lasehlotyeni liya kuba neentsuku ezisi-7 ukuya kwezili-10 zeziganeko zothulizizonke.

Lo Umfanekiso 26 ubonisa iiyure zothuli zemihla ngemihla ngenyanga, ngelixa ubuninzi bomthwalo wothuli bubhekisela kubude obuqhubekayo bemimoya enamandla kunye namaxesha okufuma aphantsi (oko kukuthi iiyure ezilandeelanayo). Ngamanye amazwi, umthwalo wothuli sisixa sipheleleyo sothuli esenziwe kwiziganeko esinye esiqhubeke ixesha eliqala ngo-01h00 ukuya ku-21h00 ngomhla wama-27 ku-Agasti 2018. Inani lilonke leeyure zothuli libonisa kuphela iiyure xa isantya somoya kunye nokufuma okulinganiselweyo kudlula imida yazo, ngelixa umthwalo wothuli ubalwa kusetyenziswa le meko kwaye ulinganiswa ngokuphambeneyo ngokubonakala.



Umfanekiso 26: Ubude obuqhelekileyo (iiYure) zeMeko yoThuli ngosuku ngenyanga

ukusuka Umfanekiso 26 Kulo mfanekiso ungasentla, inani eliphezulu leeyure zemihla ngemihla eziqhelekileyo ngenyanga laliphakathi kukaSeptemba 2013, lilandelwa nguSeptemba 2008. Ukuba sijonga ii-medians, uNovemba ufumana amanqaku aphezulu, kulandele uSeptemba noJulayi. Elona liphantsi lingoMatshi.

b) Umkhenkce unyibilika

Amathuba okunyibilika kwamanzi aqandisiweyo kwimingxuma yamatye okanye izakhiwo zekhonkrithi akunakwenzeka ukuba abekhona kwindawo leyo kuba amaqondo obushushu aphantsi abhalwe kwindawo yaseThyspunt yayiyi-4.9°C (Cape St. Francis WS) kunye ne-6.7°C (Thyspunt WS). Ukongeza, malunga nokwenzeka kokuba kubekho umkhenkce elwandle olujikeleze indawo leyo, amaqondo obushushu aphantsi amanzi olwandle alinganiswa kwiiseti zedatha yi-7.9°C. Ngenxa yesi sizathu, umkhenkce awulindelwanga ukuba wenzeke elwandle kwindawo leyo.

c) Ukugqwala komoya

Ukugqwala komoya olwandle kubangelwa kukufuma kunye neoksijini kodwa kugxininiswa zizinto ezingcolisayo ezifana neekhompawundi zesalfure kunye netyuwa etshizwayo. Ngoko ke, ukuqikelelwa kwamazinga okugqwala komoya okuqulathe igama elithi 'ixesha lokumanzi', elisebenza kubushushu bomoya ongqongileyo kunye nokufuma okuthelekisekayo, kunye nobungakanani bokungcola emoyeni, ngakumbi i-sulfur dioxide kunye ne-sodium chloride. I-ISO 9223 International Standard [12] ichaza izinto eziphambili kwi-atmospheric corrosion yeesinyithi kunye nee-alloys kwaye inika iindlela zokumisela ezi. Ngokwe-ISO 9223 International Standard amazinga okugqwala anokuqikelelwa ngokudityaniswa kobushushu obuphakathi bonyaka, ukufuma okuthelekisekayo, kunye namazinga okufumba kwe-sulfur dioxide kunye ne-chloride.

Isishwankathelo samazinga okugqwala abaliweyo kwintsimbi yekhabhoni, i-zinc, i-copper kunye ne-aluminium sinikwe kwiltheyibhile 8 ngezantsi.

Itheyibhile 8: Amaxabiso ezinga lokubolaabaliweyo kwiintsimbi ezahlukeneyo kunye namaxesha okuvezwa

Ukubola	Intsimbi i	Izinga lokubola [$\mu\text{m}/\text{year}$]
Ireyithi kunyaka woku-1	Intsimbi yekhabhoni	68.0 (50.6-81.6)
	Izinki	2.8 (2.2-3.4)
	Ubhedu	1.8 (1.5-1.9)
	I-Aluminiyam	1.0 (0.7-1.2)
Izinga eliphakathi leminyaka engaphezu kwama-20	Intsimbi yekhabhoni	8.8 - 11.1
	Izinki	1.3 - 1.6
	Ubhedu	0.4 - 0.5
	I-Aluminiyam	0.3 - 0.4

Ngokutsho kwe-ISO 9224:2012 [13], ukugqwala kukhula ngokukhawuleza ngexesha lokuvezwa kokuqala ngaphambi kokuba kunciphe ngenxa yokungashukumi komphezulu:

- “Ukuvezwa ngaphandle ixesha elide kubonisa ukuba ubunzulu bemingxuma bukhula ngokukhawuleza kwiminyaka emibini yokuqala kodwa abukhuli kangako kwiminyaka elandelayo.”
- “Ukulahleka kobunzima kukhula ngokukhawuleza kwiminyaka emibini yokuqala. Ngenxa yokwakheka komaleko we-oxide, umphezulu awushukumi kwaye amazinga okugqwala afanayo ayancipha aye kumaxabiso aphantsi.”

Oku kucacisa isizathu sokuba intsimbi yekhabhoni ibonise izinga lokugqwala lokuqala le-68 μ m/ngonyaka, ngelixa umndilili wexesha elide wehla uye kwi-8.8 – 11.1 μ m/y kwixesha leminyaka engama-20 njengoko kubonisiwe KwiITHEYIBHILE 8. Izinga eliphezulu lobomi bokuqala sisiphumo esiqhelekileyo semodeli yokugqwala komoya esekelwe kwi-ISO, ebonisa ukugqwala kokuqala okuqondwa kakuhle ngaphambi kokuba umphezulu udlule, endaweni yokubonisa nayiphi na into engaqhelekanga.

5.3.2.3.3. Iziganeko Ezinzima Nezinqaqhelekanga

Iziganeko zemozulu ezingaqhelekanga zichazwa njengeziganeko ezenzeka rhoqo. Ngoko ke, nakwesiphi na isikhululo semozulu esithile, izixhobo ezisetyenziselwa ukulinganisa rhoqo azifane zibonise iimpawu zezi ziganeko. Iziganeko zemozulu ezingaqhelekanga, ezintsonkothileyo kakhulu, zihlala zilinganiswa ngokwezinga lazo. La maxabiso obunzulu anokubonakaliswa ngokwezinga lophawu olufana nomonakalo okanye iparameter yobungakanani efana nesantya somoya.

Ukunqongophala kwezifundo ezineenkukacha malunga neengozi ezinkulu zesaqhwithi kunye nemozulu eThyspunt kwenze kwaba nzima ukuhlalutya nokudibanisa ulwazi ngeenjongo zokulinganisa ukwenzeka rhoqo. Ngenxa yoko, ulwazi oluvela kwimiba yemozulu eyenziwe yiSAWS eCape St. Francis lwaseetyenziswa. Nangona kungenakwenzeka ukulinganisa ukungaqiniseki kule ndlela, kulindeleke ukuba iipateni zemozulu ezifanayo ziya kubonakaliswa. Oku kulindeleke ngenxa yokuba indawo ikufutshane kunye neCape St. Francis WS kwaye kuba ezi ndawo zichaphazeleka ziinkqubo ezifanayo zesikali se-synoptic.

i) Imozulu embi kakhulu

Unxweme olusemazantsi nakumzantsi-ntshona waseMzantsi Afrika luphantsi kweenkqubo ezinkulu ze-synoptic scale eziqhuba iimeko zemozulu zasekuhlaleni kuyo nayiphi na indawo. Ezi meko zemozulu zasekuhlaleni zihlala zibonakaliswa ngamafu asezantsi kwaye azikho ziinkqwithela ezinkulu ezivelisa isichotho kunye neemvula zendudumo. Imozulu embi inxulunyaniswa kakhulu neemeko zomoya onzima. Iinkqubo ezine eziphambili zokuvelisa umoya zichongiwe, ezizezi: i-coastal low buster, i-cut-off lows, i-shallow south-easterlies, kunye ne-mid-latitude lows.

Le ndawo inokuba nemozulu embi ngendlela yeendudumo, isichotho, imimoya enamandla eenkanyamba, kwaye mhlawumbi neenkanyamba. Uninzi lwezivuthuvuthu ezinkulu ezenzeka eMpuma Koloni zidibene, zivelisa indibaniselwano eyahlukeneyo yesichotho, umoya, inkanyamba, umbane, kunye nezikhukula ezikhawulezileyo. Imimoya eyonakalisayo enxulunyaniswa neendudumo ezinkulu ibandakanya iinkanyamba, ii-downbursts (ii-microbursts okanye ii-microbursts), imimoya ethe tye, ii-gust fronts, kunye nee-derechoes⁴. Iirekhodi

⁴ I-downburst yenziwa yindawo yomoya opholiswe kakhulu yimvula, othi emva kokufikelela emhlabeni usasazeke kuwo onke amacala, uvelise imimoya enamandla. Ii-microburst nee-macroburst ziindidi zee-downburst ezenzeka kumlinganiselo omncinane

zembali, ezigubungela ixesha elimalunga neminyaka eyi-160 leziganeko zemozulu embi kummandla (kwisangqa esingama-100 km), zibonisa iziganeko ezingama-20 zemimoya enamandla kakhulu (gale-force) okanye imimoya embi kakhulu, kwakunye neenkanyamba ezi-3 ukuya kutsho kunyaka ka-2023. Ezi rekhodi zikwadwelisa iziganeko ezi-6 zemvula enkulu kakhulu kunye neziganeko ezingama-32 zezikhukula

ii) Izikhohlo zaseTropiki

Umandla waseThyspunt awukho kumzila wenkanyamba (inkanyamba yetropiki) okanye ecaleni kolwandle olufudumeleyo. Ke ngoko, akulindlekanga ukuba indawo leyo ibe nenkanyamba, okanye ubuncinane kukho amathuba aphantsi kakhulu. Inkanyamba zetropiki ziveliswa kwiindawo apho ubushushu bomphezulu wolwandle bungaphezulu kwama-27°C kwaye phakathi kwe-latitudes 5°S ukuya kuma-30°S. Indawo ikwi-33°S kwaye ke ngoko ayichaphazeleki ziinkanyamba zetropiki.

iii) linkanyamba

Inkanyamba yingqokelela yomoya ejikelezayo enamandla ephuma kwisiphango.

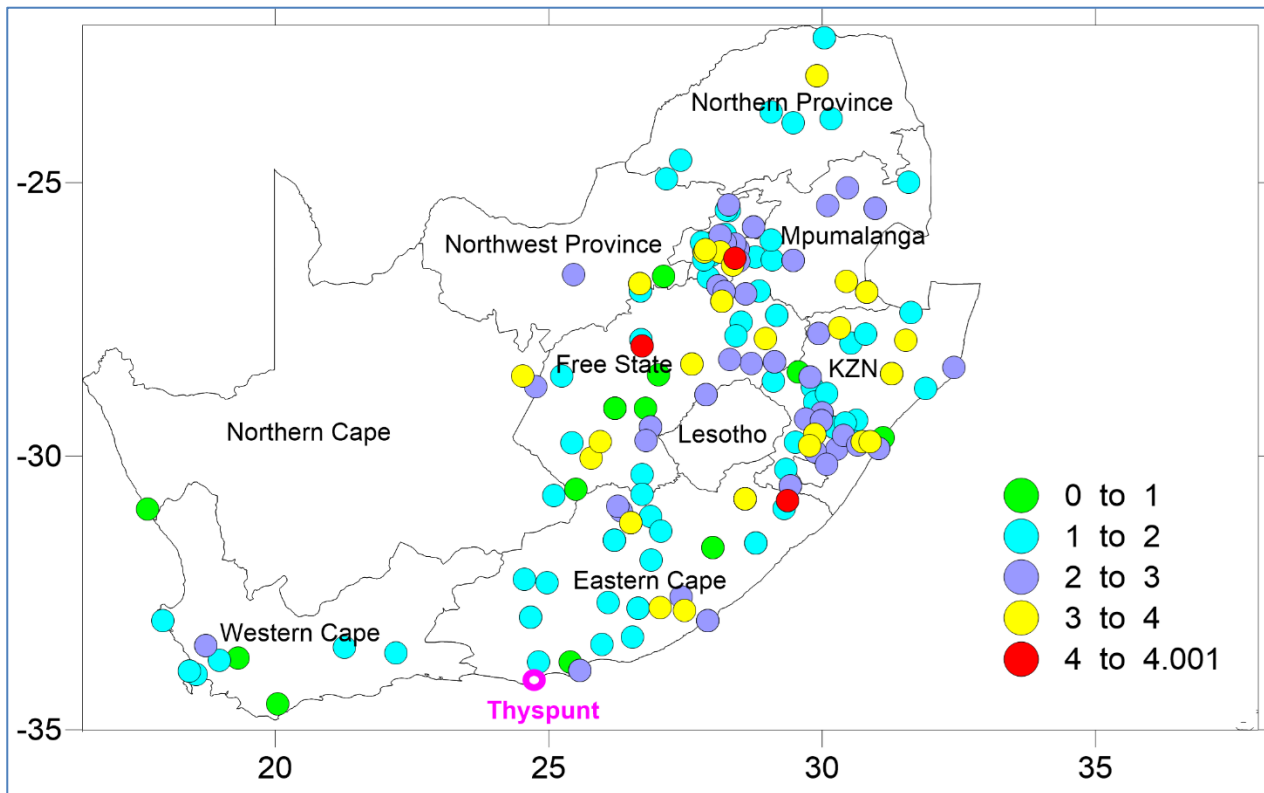
linkanyamba eMzantsi Afrika zihlala zinxulunyaniswa nomoya oshushu kakhulu kunye neendudumo ezinkulu. Kubekho iziganeko ezintandathu zeenkanyamba ngaphakathi komgama ongaphantsi kwe-100 km, ngelixa ezili-11 zenzeka ngaphaya kwe-200 km ukusuka kwindawo leyo. Iziganeko ezintandathu phakathi kwe-100 km kunye ne-200 km ukusuka kwindawo leyo, kodwa akukho bungqina beenkanyamba obufunyenweyo kwindawo leyo kunye nommandla ojikelezileyo. Ngokusekelwe kwiziganeko zeenkanyamba ezikhoyo, uqikelelo lwezihlandlo zeenkanyamba kwindawo leyo lwenziwe ngokuhlalutya iirekhodi zeenkanyamba ezikhoyo. Ezi ziquka iinkanyamba ezibonwe ukuya kuthi ga kumgama ophezulu malunga ne-320 km kusuka kwindawo leyo (KuGompo City)⁵. Umfanekiso 27 ubonisa iziganeko zeenkanyamba kwixesha eliphakathi kwe-1905 ukuya ku-2020 lizihlandlo zeenkanyamba ze-EF0 ukuya kwi-EF5 kunye nobubanzi bendlela kunye nobude zinikwe kwiltheyibhile 9 ngezantsi.

kakhulu nakumlinganiselo omkhulu ngokulandelelana. Uninzi lwee-downburst lunobungakanani obungaphantsi kwe-4 km; ezi zibizwa ngokuba zii-microburst. Ii-downburst ezinkulu kuno-4 km ngamanye amaxesha zibizwa ngokuba zii-macroburst.

Imimoya ethe ngqo (straight-line winds) ixhaphake ngaphambili kwesaqhwithi esineendudumo (gust front) okanye ivela kwi-downburst evela kwisiphango esineendudumo. Ukuba le mimoya ifikelela okanye idlule kwi-93 km/h, ke eso siphango sihlalelwa njengesiphango esinamandla kakhulu (severe storm).

Igama elithi "derecho" lisetyenziselwa ukuchaza imimoya ethe ngqo enkulu ngomlinganiselo, ehamba ngesantya esikhulu kakhulu ngaphambi komgca olungelelaniswe kakuhle nowohlala ixesha elide wezaqhwithi (squall line), okanye ngaphambi kwesiphango esikhulu esineeseli ezininzi (multiple-cell storm).

⁵ Formerly known as East London



Umfanekiso 27: Ukuvela kweenkanyamba ukususela ngo-1905 ukuya ku-2020

Itheyibhile 9: Ubuninzi boBunzima beeNkanyamba kunye noBubanzi beNdlela kunye noBude

linkanyamba		Ixabiso	
Ukunokwenzeka kweNkanyamba (EF - Isikali seFujita esiNgcono	Isekelwe kwisiseko sedatha seminyaka eli-116 ukususela ngo-1905 ukuya ku-2020	All ⁽²⁾	6.8 x 10 ⁻⁶ ngonyaka nge-km ² nganye
		EF0	1.3 x 10 ⁻⁶ ngonyaka nge-km ² nganye
		EF1	2.1 x 10 ⁻⁶ ngonyaka nge-km ² nganye
		EF2	6.6 x 10 ⁻⁷ ngonyaka nge-km ² nganye
		EF3	<1.0 x 10 ⁻⁸ ngonyaka nge-km ² nganye
		EF4	<1.0 x 10 ⁻⁸ ngonyaka nge-km ² nganye
		EF5	<1.0 x 10 ⁻⁹ ngonyaka nge-km ² nganye
	Isekelwe kwisiseko sedatha seminyaka engama-25 ukususela ngo-1996 ukuya ku-2020(1)	All ⁽²⁾	3.2 x 10 ⁻⁶ ngonyaka nge-km ² nganye
		EF0	4.0 x 10 ⁻⁵ ngonyaka nge-km ² nganye
		EF1	2.3 x 10 ⁻⁶ ngonyaka nge-km ² nganye
		EF2 ⁽³⁾	6.6 x 10 ⁻⁷ ngonyaka nge-km ² nganye
		EF3 ⁽³⁾	<1.0 x 10 ⁻⁸ ngonyaka nge-km ² nganye
		EF4 ⁽³⁾	<1.0 x 10 ⁻⁸ ngonyaka nge-km ² nganye
		EF5 ⁽³⁾	<1.0 x 10 ⁻⁹ ngonyaka nge-km ² nganye
Isantya somoya esiyi-10-7 ngonyaka:			
- isantya somoya esiphezulu		75.0 m/s 15.0 m/s	

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- inguqulelo ephezulu - ukujikeleza okuphezulu		60.0 m/s		
Ububanzi Bendlela [m]	Ikota esezantsi	Ikota epheezulu	Ixabiso eliphakathi	Umyinge
Inkanyamba ye-EF0 (amathuba angama-40% ukuya kuma-64%)	22.9	68.6	45.7	54.9
Inkanyamba ye-EF1 (amathuba angama-36% ukuya kuma-48%)	68.6	182.9	91.4	163.8
Inkanyamba ye-EF2 (0% ukuya kwi-4% amathuba)	137.2	402.3	228.6	344.1
Inkanyamba ye-EF3 (0% ukuya kwi-4% amathuba)	339.5	1005.8	548.6	736.3
Ubude beNdlela [km]				
Inkanyamba ye-EF0 (40% ukuya kwi-64%)	0.29	2.7	0.8	2.27
Inkanyamba ye-EF1 (36% ukuya kwi-48% amathuba)	1.77	9.33	4.4	7.1
Inkanyamba ye-EF2 (0% ukuya kwi-4% amathuba)	4.53	19.25	10	14.3
Inkanyamba ye-EF3 (0% ukuya kwi-4% amathuba)	12.38	36.34	23	29.1
Ukwehla koxinzelelo lwe-10-7 ngonyaka isantya somoya	40 hPa			
Izinga eliphezulu lokuhla koxinzelelo lwe-10-7 ngonyaka isantya somoya	13 hPa/s			
Amanqaku:				
(1) Umsebenzi weNkanyamba unyukile ukususela ngo-1987 ngaphakathi kwi-80 km ukusuka kwindawo leyo. Nangona utshintsho lwemozulu lusenokuba negalelo ekwandeni kwamaza eenkanyamba, kusenokwenzeka ukuba iingxelo zeenkanyamba zinyukile ngenxa yokusasazeka kwabantu kunye nomonakalo ohambelana noko kwipropati. (2) Ungeniso lwe-“All” tornado ludibanisa zonke iifrikhwensi ukusuka kwi-EF0 ukuya kwi-EF4 kwitheyibhile. (2) Ungeniso lwe-“All” tornado ludibanisa zonke iifrikhwensi ukusuka kwi-EF0 ukuya kwi-EF4 kwitheyibhile. (3) Akukho ziqhwithi zinkulu kune-EF2 ezibonwe kwiminyaka engama-34 yokunika ingxelo kwaye ngenxa yoko zithathelwe ingqalelo kwixabiso elifanayo nelohlalutyo lwexesha elide.				

iv) Umbane

Idatha yombane iqokelelwe kufutshane nendawo, kwaye i-SAWS ibonelele ngedatha esebenzayo ukususela ngoJulayi 2007 ukuya kuDisemba 2008. Inani leemivuthuzo ezirekhodiweyo ngeli xesha yayiyi-211. Inani eliqhelekileyo leemivuthuzo ngeflash nganye yayiyi-5 kunye nobuninzi be-16. Indawo ebandakanyiweyo ekuqwalaselweni yayimalunga ne-15.8 km nge-15.9 km. Ngenxa yoko le ndawo ifumana umbane ongaphantsi kwe-1 ngonyaka nge-km². Umbane ophezulu welifu ukuya emhlabeni orekhodiweyo ngeli xesha yayiyi-166 kA (kiloampere) kunye nomyinge we-25 kA.

Imisebenzi yombane ikwalinganiswe kwi-Thyspunt WS ukususela ngoJuni 2017 ukuya ku-Okthobha 2019. Inani eliqhelekileyo lonyaka leemivuthuzo ezilinganiswe kwi-Thyspunt WS yayiyi-179 887 strokes. Inani leefleshi liqikelelwe xa kucingelwa ukuba ubuncinane ii-2.5 strokes ngefleshi nganye njenge- Ulinganiselo oluphezulu (iifleshi ezili-14 710), ii-25 strokes ngefleshi nganye njenge- Ulinganiselo oluphantsi (iifleshi ezili-1 765) kunye nee-13.75 strokes ngefleshi nganye (ixabiso eliphakathi) njenge- Ulinganiselo oluphakathi (iifleshi ezili-7 881).⁶ Ubuninzi befleshi yexesha lokubeka esweni ke ngoko buqikelelwe ukuba buphakathi kwe-0.4 kunye ne-3.3 strokes nge-km², kunye nexabiso eliphakathi leefleshi ezili-1.8 nge-km², elingaphezulu kancinci kunee-SAWS observations.

5.3.2.3.4. Ezinye Iziganeko Ezimbi Zemozulu

Iziganeko ezingaqhelekanga ezifana neenkanyamba zasetropikini, ukugqunywa ngumkhenkce nomkhenkce, iimvula ezinkulu, kunye nembalela ziyahlolwa ngenxa yedatha yemozulu echazwe apha ngasentla kunye nenyano yokuba ulwandle lusebenza njengendawo yokukhupha ubushushu. Akulindelwanga ukuba umkhenkce wenzeke elwandle kwindawo leyo.

5.3.2.4 Iziganeko Zamanzi

Ummandla wendawo uhlolwe ukuze kufunyaniswe ukuba kukho izikhukula ngenxa yesizathu esinye okanye ezingaphezulu zendalo ezinokuchaphazela ukhuseleko lokufakelwa kwenyukliya ezifana nokuhla kwamanzi, ukunyuka kwesivuthuvuthu, ukuxinana kwamanzi, kunye namaza omoya. Yonke idatha efanelekileyo, kuquka idatha yembali, zombini imozulu kunye neyamanzi, yaqokelelwa yaza yahlolwa ngokunzulu.

Imodeli efanelekileyo yemozulu kunye neyamanzi yaphuhliswa kuthathelwe ingqalelo imida yokuchaneka kunye nobungakanani bedatha, ubude bexesha lembali apho idatha

⁶ Ukudanyaza kombane (flash) kuquka ukubetha okubuyayo okukodwa (return stroke) okanye mhlawumbi ukuya kutsho kuma-25 okubetha okubuyayo (Rakov, 2007; Gill, 2009). Izifundo zamazwe ngamazwe ezenziwe ngobuninzi bokubetha (stroke multiplicity) kwiimbane ezisuka emafini ziye emhlabeni (cloud-to-ground okanye CG lightning flashes) zafumanisa ukuba umndilili wobuninzi bokubetha okungalunganga (negative stroke multiplicity) wawuyi-4.6 eFlorida, 6.4 eNew Mexico, 3.4 eSweden, kunye ne-4.5 eSri Lanka ngokulandelelana (Rakov & Huffines, 2003). Ubuninzi obufanayo bokubetha kwe-CG obuyi-4.2 bafunyanwa eMzantsi Afrika nguSchonland (1956), kwaye obuyi-3.5 bafunyanwa nguMalan (1956) [10].

yaqokelelwa khona, kunye nazo zonke utshintsho olwaziwayo kwiimpawu ezifanelekileyo zommandla.

Iindibaniselwano ezinokwenzeka zeziphumo zezizathu ezahlukeneyo nazo zahlolwa. Umzekelo, amathuba okukhukula ngokudityaniswa kokuhla kwamanzi, iziphumo zomoya kwimizimba yamanzi, kunye nezenzo zamaza zahlolwa kwaye zathathelwa ingqalelo kwimodeli yengozi.

Iingozi zendawo ngenxa yokukhukula zafunyanwa kwimodeli. Iiparameter ezisetyenzisiweyo ukuchaza iingozi ngenxa yokukhukula zaziquka ukuphakama kwamanzi, ukuphakama kunye nexesha lamaza, ixesha lesilumkiso lesikhukula, kunye nobude beemeko zezikhukula kunye nokuhamba kwamanzi.

Amaxabiso amanqanaba aphezulu kakhulu amanzi olwandle kunyenamathuba onyaka okugqitha afunyenwe, kuquka iziphumo ezinokubakho zotshintsho lwemozulu. Amanqanaba aphantsi kakhulu amanzi olwandle nawo ahlalutywe kwaye alinganiswa.

Kuphandwe ngamathuba okungazinzi kommandla wonxweme ngenxa yokukhukuliseka okanye ukubola kwelitye.

Kuphandwe nangala mmandla ukuze kufunyaniswe amathuba eetsunami okanye iiseiches ezinokuchaphazela ukhuseleko lokufakelwa kwenyukliya kwindawo leyo.

5.3.2.4.1 Izikhukula Ezivela Elwandle

Izikhukula ezivela elwandle zinokwenzeka ngenxa yezi zinto zilandelayo:

Ukungena kwamaza elunxwemeni kudityaniswe nokunyuka komgangatho wolwandle, amaza aphezulu olwandle, ukonyuka komgangatho wolwandle okubangelwa sisiphango, kunye nokunyuka komgangatho wamanzi okubangelwa kukuqokelelana kwamaza; kunye

- Ukunyuka kwamaza esiphepho kunye nokunyuka kolwandle, amaza aphezulu, ukunyuka kwesiphepho kunye nokubekwa kwamaza; kunye
- Ukunyuka kwamaza esiphepho kunye nokunyuka kolwandle, amaza aphezulu kunye nokunyuka kwesiphepho okuhle.
- Ingozi yezikhukula iyanda ngokuhamba kwexesha ngenxa yotshintsho lwemozulu olubangela ukunyuka komgangatho wolwandle kunye nokwehla koqoqosho oluhambelanayo nonxweme, imozulu yamaza ajikelezayo, kunye nokunyuka kokuphakama kwamaza esiphepho kunye nokunyuka kwesiphepho.
- Inqanaba eliphezulu loqikelelo oluphezulu lokuhamba ngokuthe nkqo ngo-2034 ngenxa yesiphepho se-1E-08 y-1 yi-13.3 m msl, enyuka ukuya kwi-17.6 m msl ngo-2134.

Izikhukula ezivela elwandle ke ngoko zichongwa njengengozi enkulu ekufuneka ithathelwe ingqalelo kuyilo lofakelo lwenyukliya, oko kukuthi, ithala kufuneka libekwe emhlabeni wemida

ephezulu yezikhukula, okanye izakhiwo zokukhusela ezifana neendonga zamaza kunye neendonga zamaza kuya kufuneka zibekwe phambi kwethala.

5.3.2.4.2 Izikhukula Zangaphandle Ezivela Kwezinye Iindawo

Ezinye iimeko zezikhukula ekufuneka ziqwalaselwe xa kufakelwa inyukliya kwindawo leyo zezo zinokubangela ukuba amanzi angabi sendaweni ixesha elide, nto leyo enokubangela iziphumo ezingashukumiyo (ubunzima bamanzi) kunye nemithwalo enamandla kwizixhobo zenyukliya. Amava okusebenza avela kwizixhobo zenyukliya ezikhoyo anika ubungqina beziganeko zangaphandle ezibangelwa zizikhukula apho ukusebenza kwezixhobo ezinxulumene nokhuseleko kuye konakala. Uninzi lwazo lunxulumene nokungabikho kwemilinganiselo yokukhusela indawo, ukugcinwa kakubi kweenkqubo zokuhambisa amanzi kunye nemiphumo yomkhenkce kwiindawo zomlambo. Izibonelelo zeziganeko ezinjalo zinxulumene kakhulu noyilo.

5.3.2.4.3 Izikhukula namaza abangelwa kukungasebenzi kakuhle kwezakhiwo zokugcina amanzi

Iingozi ezinxulumene nokusilela kwezakhiwo zolawulo lwamanzi (umz. amadama) ziphandiwe. Iingozi ezivela kutshintsho kumjelo wendalo wemilambo nazo ziphandiwe. Akukho madama abalulekileyo okanye iindlela zamanzi ezichaziweyo ezikwindawo yokugcina amanzi ye-quaternary K80F ephuma amanzi ukuya kwindawo yaseThyspunt. Kukho ulwahlulo lweendawo zokugcina amanzi (ummandla osemantla nowasemazantsi), kwaye ummandla osemantla uphuma amanzi kwiindunduma kwaye awufikeleli kwindawo egubungeleyo. Amanzi akhoyo adala iindawo zokugcina amanzi zendalo ezingenakubangela ukugcinwa kwamanzi amaninzi. Akukho zithintelo ezenziwe ngabantu ezinqumla umlambo ezinokunyusa kakhulu intloko yamanzi kwaye zinokubangela ukuqhekeka ngexesha lesiphango esibangela ukwanda nomonakalo kwiziseko zophuhliso ezisezantsi.

Ngenxa yeendawo ezininzi zamachibi okwethutyana eziphakathi kweendunduma, ukuhamba kwamanzi okuphantsi, kunye nesantya, kukho ukukhukuliseka okuncinci kunye nokwenzeka komonakalo okunokuchaphazela ukhuseleko lokufakelwa kwenyukliya. Nakuphi na ukukhukula okunokwenzeka ngenxa yokutsalwa kwamanzi ngaphakathi komlambo akunamsebenzi kwaye akuyi kuchaphazela ukhuseleko lokufakelwa kwenyukliya.

Ngenxa yoko, ngokwembono yokhuseleko lwendawo, ukufakwa kwenyukliya akuyi kubekwa ecaleni kwemijelo emikhulu yamanzi enokuchaphazela indawo ngexesha lesiganeko esikhulu sezikhukula zangaphandle. Ngenxa yeendawo ezincinci ezinegalelo, amanqanaba aphezulu ezikhukula achaphazeleka ngamanqanaba aphezulu amanzi asezantsi kunokuba amanqanaba amanzi aveliswa ngamanzi angaphezulu avela kwiindawo ezincinci ezigcina amanzi.

5.3.2.4.4 Imililo yangaphandle

Imililo yangaphandle iphandwe ngengqwalasela efanelekileyo malunga nokhuseleko lwesakhiwo (umz. ukufikelela kwindawo, ukufumaneka kombane, umoya ophumayo, njl.njl.) kugxininiswa kakhulu ekungafumaneki kombane okanye nasiphi na isoyikiso kwisenzo

somqhubi ngenxa yokukhululwa komsi kunye neegesi ezinobuthi. Imililo yangaphandle yimililo eyenzeka ngaphandle komda wendawo, umz. imililo yamahlathi/yamahlathi kunye nokuchitheka kweoyile elwandle. Iingozi ezinokubakho kukulahlekelwa ngumbane ongaphandle kwendawo (i-LOOP), ukuvalelwa ngokunyanzelwa komoya wokufakelwa kwenyukliya, kunye nempembelelo kwindawo yokuhlala kwigumbi lolawulo. Ukukhuselwa kofakelo lwenyukliya kwimililo kufuneka kufezekiswe ngokunciphisa amathuba okuba kubekho umlilo kunye nokubonelela ngemiqobo kwimililo yangaphandle.

Imililo kwindawo iyathintelwa ngokusekwa nokulawulwa kweendawo zokucima umlilo kunye nokususwa kwezityalo zasemzini ngokuhambelana nesicwangciso solawulo lokusingqongileyo esivunyiweyo. Ukusetyenziswa komhlaba ojikeleze indawo yofakelo lwenyukliya kuya kulawulwa ukuze umlilo ongaphandle ungasasazeki uye kwisityalo.

5.3.3 Iziganeko Zangaphandle Eziquhutywa Ngabantu

Iziganeko ezibangelwa ngabantu zithathwa njengeziganeko ezingalindelekanga (umz. ukuchitheka kweoyile kunye nokuqhuma kwezinto eziyingozi). Imithombo enokubakho yeengozi ezibangelwa ngabantu eziphandweyo yile:

- Amathuba okungqubana kweenqwelo-moya kwindawo, kuthathelwa ingqalelo kangangoko kunokwenzeka kwiimpawu zendlela yomoya kunye neenqwelo-moya kwixesha elizayo.
- Imisebenzi eyenzeka kulo mmandla equka ukuphathwa, ukucubungula, ukuthutha kunye nokugcinwa kweekhemikhali ezinokubangela ukuqhuma okanye ukuveliswa kwamafu egesi anokudilika okanye ukuqhuma.
- Izixhobo ezinokubangela imijukujelwa yalo naluphi na uhlobo enokuchaphazela ukhuseleko lofakelo lwenyukliya.
- Imithombo enokubakho (engashukumiyo nehambayo), kubandakanya nomlilo wangaphandle.

Injongo yokugqibela yophando kukuchonga izixhobo zothutho, ezoluntu, ezoshishino, nezomkhosi ezingaphandle komda olawulwa ngumnini ezinokuchaphazela ukuba kunokwenzeka ukuphumeza izicwangciso zongxamiseko okanye imisebenzi enokuba yingozi enokuba yingozi ekufakweni kwenyukliya kwindawo leyo kunye nokuchonga imithombo yeengozi zangaphandle ngaphakathi nangaphandle komda olawulwa ngumnini ukuze kuqinisekise ukhuseleko lokufakelwa kwenyukliya kwiziganeko zangaphandle ezibangelwa ngabantu.

5.3.3.1 Iingozi Zeenqwelo-Moya

I-NNR ifuna uvavanyo oluthile loyilo lweziphumo ekufakweni kwenyukliya kwempembelelo yenqwelo-moya enkulu yorhwebo okanye yomkhosi. Ukufakelwa kwenyukliya kufuneka kuyilwe ukuze kumelwane nempembelelo yengozi yenqwelo-moya esekwe kuyilo ngaphandle kokulahlekelwa ngumsebenzi wokhuseleko. Amathuba okuwa kweenqwelo-moya kwindawo ahlolwe kuthathelwe ingqalelo kangangoko kunokwenzeka, yeempawu zendlela yeenqwelo-

moya yexesha elizayo kunye neenqwelo-moya (zombini zomkhosi nezorhwebo). Ukugcinwa kabini kunye noyilo loyilo oluphambili lokufakelwa kwenyukliya ukunciphisa iiprofayili ezithe nkqo ngaphezulu komhlaba zibonelela ngeenzuzo zokuchasana neziganeko zangaphandle ezibangelwa ngabantu ezingenakuchazwa ngokunokwenzeka. Ulwazi olubalulekileyo malunga neenqwelo-moya kunye neendlela zomoya lungashwankathelwa ngolu hlobo lulandelayo:

- Isikhululo seenqwelo-moya saseSt. Francis (13,4 km empuma) yeyona sikhululo seenqwelo-moya kuphela ngaphakathi kwe-16 km ukusuka kwindawo. Isikhululo seenqwelo-moya sinendawo enye yokubaleka enengca engu-10/28, enomlinganiselo omalunga ne-1 000 x 12 m. I-10/28 ibhekisa kwindlela yokujonga umbane yesiphelo ngasinye sesikhululo seenqwelo-moya apho u-"10" uthetha ukuba indlela yokubaleka ijonge kwi-100° magnetic kwaye u-"28" uthetha ukuba icala elichaseneyo lijonge kwi-280° magnetic. Isikhululo seenqwelo-moya senzelve ukwamkela iiLearjets, kwaye asikwazi ukwamkela izithuthi zesiqhelo, zorhwebo, okanye zikawonke-wonke. Isikhululo seenqwelo-moya sisebenza imihla ngemihla kwaye asinayo inqaba yokulawula kodwa sinezibane zokufika kunye nee-hangers ezingama-20 zokugcina nokugcina iinqwelo-moya ezincinci zabucala. Akukho petroli yeenqwelo-moya egcinwa kwindawo. Uhlobo lwenqwelo-moya olukhulu isikhululo seenqwelo-moya esinokuthwala ubunzima obungaphantsi kwe-5.7 t. Akukho ngozi zeenqwelo-moya ezenzekileyo kwisikhululo seenqwelo-moya ngokweerekhodi ezigcinwe yi-Civil Aviation Authority (CAA) ukususela ngo-1998 ukuya ku-2024. Okwangoku akukho zicwangciso zokwandiswa kwexesha elizayo kwesikhululo seenqwelo-moya.
- Isikhululo seenqwelo-moya esingaphandle kwe-16 km esibalulekileyo yiChief Dawid Stuurman International Airport (DSIA) (85 km empuma-mpuma-mpuma), elawula zonke iindiza zasekhaya zommandla osemazantsi-mpuma woMzantsi Afrika. Iingozi ezimbini zeenqwelo-moya zenzeke kwisikhululo seenqwelo-moya ukususela ngoJanuwari 1997 ukuya kuMeyi 2008 ngokweerekhodi ezigcinwe yi-Civil Aviation Authority.

Imisebenzi yokuhamba kweenqwelo moya kwi-DSIA ingaphantsi kakhulu kunemilinganiselo yokujonga umgama we-1 000 X d2. Ipharamitha d ngumgama ngeekhilomitha ukusuka kwisikhululo seenqwelo moya esikhulu ukuya kwindawo ethile. Uhlalutyo lomngcipheko olwenziweyo lubonisa ukuba isikhululo seenqwelo moya siya kubona ukukhula kwezithuthi zomoya kwixesha elizayo, kodwa olu kukhula luya kuba kwicala elingasentla laseGoli naseYurophu. Olu phononongo lubonisa ukuba ukwanda kweenqwelo moya eziya nokubuya eKapa akuyi kuchaphazela amaza abalwe ukumisela umngcipheko njengoko:

- I-DSIA ikude ngokwaneleyo kwindawo leyo ukuba ingabandakanyi iingozi ezinxulumene nezikhululo zeenqwelo-moya; kwaye
- Amaxesha okuphahlazeka kweenqwelo-moya asekelwe kwidatha yembali yeengozi kulo lonke ilizwe laseMzantsi Afrika kwiminyaka eli-10 edlulileyo. Akukho nto ibonisa

ukuba ukwanda kwezithuthi zomoya kuya kubangela ukuba indawo ephezulu yeengozi ibe nezihlandlo zokuphahlazeka eziphezulu kunezinye iindawo zelizwe.

Isithuba somoya siphantsi kolawulo lwe-DSIA. Indlela enkulu yesikhululo seenqwelo-moya ekufutshane nendawo yeyokuhamba ngeenqwelo-moya ezicwangcisiweyo phakathi kwe-DSIA neKapa. Uhlalutyo lubonisa ukuba i-OKSET kufuneka iphandwe ngakumbi ukuze kufunyanwe umgama osuka kwindlela yenqwelo-moya, njengoko iingcebiso ze-IAEA zibonisa ixabiso lomgama wokuhlola we-4 km ukusuka kwindawo yeenqwelo-moya.

Amaza okuwa kweengozi amiselwe kwizikhululo zeenqwelo-moya kunye nemisebenzi enxulumene nokuwa kweendiza. Iingozi ezenzeka ngexesha lokuwa kweengozi kwinqwelo-moya nge-km2 nganye kwilizwekazi laseMzantsi Afrika zimiselwe kwiingozi zeenqwelo-moya zakudala kwiindidi ezahlukeneyo. Amanqanaba okuwa kweengozi, ngokusekelwe kwidatha ekhoyo ngexesha lohlahutyo lomngcipheko ashwankathelwe kwiltheyibhile 10.

Itheyibhile 10: Izinga lilonke lokuphahlazeka kweenqwelo-moya ezahlukeneyo kwindawo yaseThyspunt

Iudidi lweenqwelo-moya			Izinga lokuKhubeka loNyaka (/y/km2)			
			Umyinge	5%tile	50%tile	95%tile
Iinqwelomoya zasekuhlaleni	Iinqwelomoya zoRhwebo		2.08E-07	4.91E-08	1.90E-07	4.07E-07
	Iinqwelomoya Jikelele	Iphiko Elizinzileyo	5.42E-06	3.66E-06	5.40E-06	7.25E-06
		Iihelikopta	1.75E-06	1.27E-06	1.73E-06	2.29E-06
Inqwelo-moya yomkhosi		Enkulu	1.09E-07	1.94E-08	9.18E-08	2.59E-07
		Encinci	1.64E-07	4.47E-08	1.46E-07	3.44E-07
		Iihelikopta	1.67E-04	1.74E-05	1.68E-04	3.18E-04

Kubalulekile ukuqaphela ukuba ukuphahlazeka kweenqwelo moya kubandakanywa njengesiganeko esiqhelekileyo esinemisebenzi ethile yomthwalo kwisiseko soyilo lwezixhobo zenyukliya ezisetyenzisiweyo (uyilo oluneeparameter ezaziwayo ezisetyenziswa kuhlalutyo ukuvavanya ukuthotyelwa kweemfuno zomthetho), nokuba zithini na izinto eziqwalaselwayo xa kuphahlazeka iinqwelo moya. I-Westinghouse AP1000, i-Fratome EPR kunye nee-reactors ze-HPR1000 zaseTshayina, zinezakhiwo eziqinisekisiweyo ukuba ziyakwazi ukumelana nempembelelo yeenqwelo moya ezinkulu zorhwebo kwaye ziquka ezi mpawu zokhuseleko zilandelayo:

- Ukwenza umsebenzi wokupholisa ngokunciphisa ukusetyenziswa kwesenzo somsebenzisi;
- Ukuthintela okuqinileyo (i) akuyi kugqobhozwa yimpembelelo yenqwelo-moya enkulu yorhwebo, kwaye (ii) kuya kugcina amandla okugqibela oxinzelelo, ngenxa yesiganeko somonakalo oyintloko de kusetyenziswe amaqhinga okunciphisa asebenzayo. Amaqhinga okunciphisa asebenzayo ngalawo abonelela, ixesha elingenammisselo, ukupholisa okwaneleyo kumbindi owonakeleyo okanye

ukuthintela ukunciphisa ubushushu kunye nemingeni yoxinzelelo engaphantsi kwamandla okugqibela oxinzelelo lokuthintela.

- Ukuthembeka kwedama lamafutha asetyenzisiweyo (UFP): Impembelelo yenqwelo-moya enkulu yorhwebo eludongeni lwe-UFP okanye kwizakhiwo zenkxaso ayizukubangela ukuvuza kwi-liner ye-UFP ngaphantsi komgangatho wamanzi ofunekayo edamini.

5.3.3.2 Ukuqhuma Kunye Nokukhutshwa Kwegesi Ebangela Ukubila/Ukubola/Ityhefu

Imisebenzi eyenzeka kulo mmandla equka ukuphathwa, ukucubungula, ukuthutha, kunye nokugcinwa kweekhemikhali kunye neziqhushumbisi ezinokuxhalabisa ngokhuseleko, ezifana nokuqhuma kunye nokukhutshwa kwegesi ebangela ukuphefumla/ityhefu, iphandwe. Iziphumo ezivela kwiziganeko zangaphandle ezibandakanya izinto ezinobungozi zingonakalisa izakhiwo zokufakelwa kwenyukliya, iinkqubo, kunye namacandelo okanye zithintele abasebenzi abasebenza ngenxa yeegesi ezinobungozi, imitha yobushushu, kunye/okanye uxinzelelo olugqithisileyo lokuqhuma. Amaxabiso eeparameter zomngcipheko othintelayo apho iziphumo ziya kuthathwa 'zikhuselekile' kwaye zingabi sisongelo kubomi ngenxa yeziganeko, umz. ukusilela kwezakhiwo, zinikwe kwiltheyibhile 11⁷.

Itheyibhile 11: Amaxabiso alinganiselweyo kwiziganeko zangaphandle ezinxulumene nezinto ezinobungozi

Ingozi	Ipharamitha yeNgozi	Ixabiso loHlolo
Umlilo wedama lokuqubha	Imitha yobushushu (1)	2,9 kW/m ²
Umlilo weJet	Imitha yobushushu	2,9 kW/m ²
Umlilo okhawulezayo	Imida enokutsha	½ LFL (2)
Ukuqhuma komphunga okhulayo wolwelo olubilayo (i-BLEVE)	Imitha yobushushu	2,9 kW/m ²
Ukuqhuma	Uxinzelelo olugqithisileyo	2 kPa

⁷ (1) Ixabiso lokuhlola (screening value) eliyi-2.9 kW/m² lilungiselelwe ngokusekelwe kwelona xabiso liphezulu lemitha yelanga yemihla ngemihla eliyi-1.1 kW/m².

Appendix A(2) BLEVE (Boiling Liquid Expanding Vapour Explosion): Ukuqhuma okwenzeka xa ulwelo olubilayo lwanda lube ngumphunga phantsi koxinzelelo, lubangele ukuqhuma okunamandla.

Appendix B(3) LFL (Lower Flammable Limit): Owona mda usezantsi wokuxinana kwegesi okanye umphunga emoyeni apho unokutsha xa kukho umthombo wokulayita.

Appendix C(4) IDLH (Immediately Dangerous to Life or Health): "Ngoko nangoko iyingozi ebomini okanye empilweni". Ibhekisa kowona mlinganiselo uphezulu wento eyingozi umntu osempilweni anokuchanabeka kuwo kangangemizuzu engama-30 aze akwazi ukubaleka ngaphandle kokufumana iziphumo zempilo ezingenakuguqulwa okanye iimpawu ezithintela ukubaleka. Ezi mpawu zinokwahluka ukusuka ekuphumeni kweenyembezi emehlweni okwethutyana okuphazamisa ukubona ukuya kwimeko yokungabikho zingqondweni (coma)

Ingozi	Ipharamitha yeNgozi	Ixabiso loHlolo
Ilifu elinobungozi	Ukugxila	IDLH (3)

5.3.4 Uvavanyo lweMpembelelo enokubakho yeZiko leNyukliya kwiNgingqi yeSayithi

5.3.4.1 Ubuninzi babantu (ukukhula nokusasazwa kwabo)

limpawu zangoku nezexesha elizayo zabemi kummandla wendawo nakwindawo ekufutshane ziphandwe ukuze kuncedwe ekuvavanyeni iziphumo ezinokubakho zokufakelwa kwenyukliya okucetywayo kuluntu kulo mmandla. Idatha efanelekileyo kwiDemografi Universe yi- Inyanga yaPhando yeNkqubo zeNdalo (ESRI) South Africa kunye ne-IRL Consulting zisebenze njengesiseko sokuhambelana nedatha yobalo lwabantu luka-2011 yokusasazwa kwabemi ngaphakathi kwendawo. Izicwangciso zophuhliso lwendawo kunye nezikhokelo nazo zisetyenzisiwe ukunceda ekuqikeleleni inani labantu eliqikelelweyo kulo mmandla (oko kukuthi amazinga okukhula aqikelelweyo kunye neendawo zophuhliso eziqikelelweyo). Iingqikelelo ⁸ zenziwe ngokusekelwe kumazinga okukhula kwabemi kunye nezicwangciso zophuhliso olunokwenzeka kulo mmandla. Amanani aqikelelweyo kwiindidi ezimbini zabemi abasisigxina kunye nabemi bexeshana aqokelelwe ngokwahlukeneyo ngokwedatha ekhoyo. Amaqela abalulekileyo abemi abanemikhwa ethile yokutya kunye neendawo ezithile zeentlobo ezithile zomsebenzi kulo mmandla nawo aqwalaselwe.

Kufuneka kuqatshelwe ukuba ngexesha lokuqulunqwa kwe-PID, idatha ye-census ka-2022 encinci yendawo (SAL) ayikakhutshwa yi-StatsSA. I-StatsSA ayikwazanga ukuqinisekisa ukuba idatha ye-SAL iya kufumaneka nini. Ngoko ke ubalo lwabantu luka-2011 lubonelela ngedatha esisiseko yenkcazo.

5.3.4.1.1 Ukusasazwa Kwabantu Ngoku

i) Abemi abasisigxina

a) Abemi

Uhlahutyo lubonise ukuba inani labantu abamalunga ne-119 615 lihlala ngaphakathi kwe-50 km ukusuka kwindawo ngo-2022 (jonga Umfanekiso 28). Amanani amakhulu abantu akwintshona-emanthla-ntshona, emantla-empuma (eyona iphezulu), emantla-mpuma nasempuma ukusuka kwindawo leyo, nto leyo ehambelana neendawo zokuhlala zasezidolophini ngaphakathi komasipala

¹² (1) The screening value of 2.9 kW/m² has been adjusted for the maximum daily solar radiation value of 1.1 kW/m²

BLEVE: Boiling Liquid Expanding Vapour Explosion

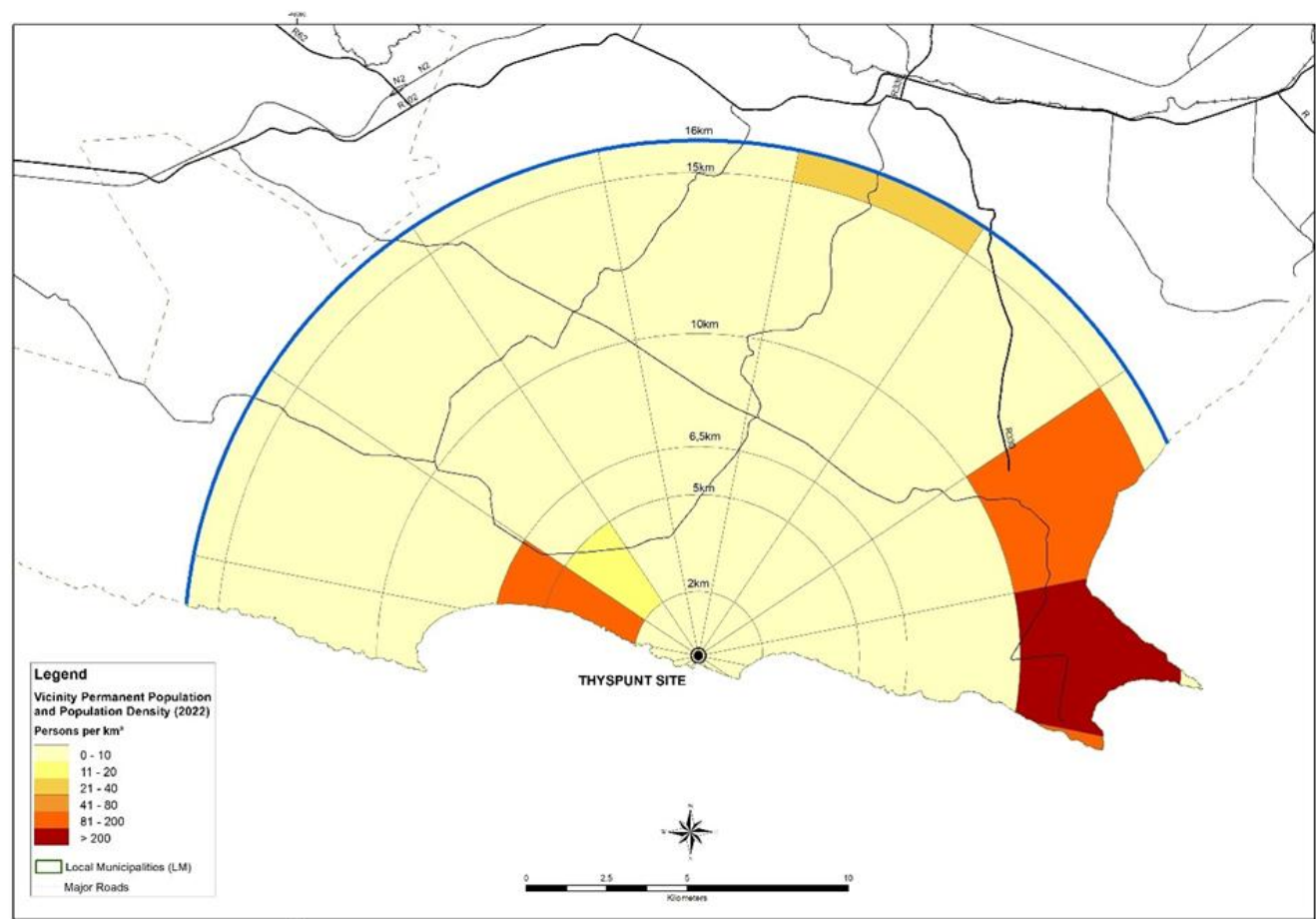
(2) LFL: Lower Flammable Limit

(3) IDLH: Immediately Dangerous to Life or Health (IDLH) and refers to the maximum concentration to which a healthy person may be exposed for 30 minutes and escape without suffering irreversible health effects or symptoms that impair escape (ranging from runny eyes that temporarily impair eyesight to a coma).

baseKouga naseKoukamma. Iindawo zokuhlala eziphambili ziboniswe kwiltheyibhile 12.

b) Amaziko/uxinano lwabantu

Ngokuhambelana neengcebiso zamazwe ngamazwe, amaziko anabantu abamalunga nama-25 000 akufuneki abe kufutshane ngaphezu kwe-6,5 km ukusuka kwindawo ye-reactor, njengoko uxinano lwabantu abamalunga nama-200 ngekhilomitha yesikwere ngaphakathi kwalo mgama luya kuvelisa inani labantu abamalunga nama-25 000 (malunga ne-16 km kubantu abayi-100 000, i-35 km kubantu abayi-500 000, kunye ne-50 km kubantu abayi-1 000 000) (Umfanekiso 28). Ngokusekelwe kwi-Ideal Dataset ye-Demographic Universe kunye ne-IRL Consulting kuquka idatha yobalo lwabantu luka-2011, indawo iyahambelana nesi sikhokelo.



Umfanekiso 28: Ubuninzi babantu abahlala kwindawo ethile (2022)

Ittheyibhile 12: lindawo zokuhlala eziphambili ngaphakathi kommandla we-50 km (2022)

Isivumelwano sokuhlawula	Umgama (km)	Isikhokelo	Inani labantu (2011)
Oyster Bay, Umzamowethu	3.5 to 5.5	W/NW	818
St. Francis Bay/ Cape St. Francis	10 to 15	E	6 513
Humansdorp/KwaNomzamo	17 to 26	N/NNE	28 990
Jeffreys Bay	24 to 29	NE	32 762
Hankey	38 to 46	NNE	13 882
Kareedouw	42.5 to 47.5	WNW	5 649
Patensie	47.5 to 50	N/NNE	6 071

5.3.4.1.2 Abemi bexeshana

Amaqela abantu bexesha elifutshane okanye abexesha elifutshane ahlalutyiweyo kummandla waseThyspunt ngalawo malungu oluntu ahlala ixesha elifutshane (iintsuku okanye iiveki) kwindawo (njengendawo yokukhempisha) enokufunyanwa kwangaphambili. Oku akubandakanyi amalungu oluntu anokuba ahamba kulo mmandla. Ngenxa yoku, idatha malunga neendawo zokuhlala, iindawo eziphambili zokuzonwabisa, imicimbi ephambili yezemidlalo neyeekonsathi yonyaka, iilwandle, iindawo ezinkulu zokuthenga kunye neendawo eziphambili zeenkomfa zifunyenwe ngophando lwedesktop kunye nophando lwendawo olwenziwe ngo-2024. Ukongeza, inani labantu abaya elunxwemeni ngolunye unxweme lwalo lonke larekhodwa ngomhla wama-31 kuMatshi 2018, oko kukuthi, ngempelaveki yePasika kwaye kwakhona ngomhla wama-23 kuSeptemba 2024, oko kukuthi, ngexesha leholide yesizwe ngophando lwasemoyeni.

5.3.4.1.3 Abemi babakhenkethi

Abacebisi be-Datavision Marketing and Tourism Research benze uphando ukuze, phakathi kwezinye izinto, balinganise inani elipheleleyo labakhenkethi ngonyaka ka-2024 nangaliphi na ihlobo ngosuku olulodwa ngexesha lendawo engummiselo ophezulu ngaphakathi kwindawo yesiza. Inani eliphakame elifunyenwe ngomhla ngamnye ophakathi kwenyanga ephezulu lisuka kwi-80 km ukusuka kwisiza lilinganiselwe kwi-6 287 abantu ngosuku.

Amandla aphezulu okupheleleyo abakhenkethi abahlala kwiindawo zokuhlala ezisemthethweni alelinye lahlalutyiwe phakathi kwe-7 606 ukuya ku-7 856 abakhenkethi ngosuku (eliphakathi kwi-7 731 abakhenkethi). Ixesha eliphezulu lendawo lalingaqinisekiswa ukusuka ngeyeNkanga ukuya kweyeTshazimpuzi, kunye noJanuwari noDisemba beyingenyanga ezimbini ezimatasa kakhulu. Inyanga kaDisemba yayingenyanga ethathe inxaxheba enkulu kakhulu

lingcali zoPhando lwezoThengiso lweDatavision kunye noKhenketho zenze uphando, phakathi kwezinye izinto, ukuze ziqikelele inani lilonke labakhenkethi ngo-2024 nangaliphi na usuku ngexesha lexesha. Inani labakhenkethi liqikelelwe ngo-2024, ngokweminyaka elishumi ukusuka ngo-2026 ukuya ku-2126 nango-2130. Njengoko amanani okhenketho ayengafumaneki ngokweNdawo eBaliweyo, iindawo ezincinci okanye iindawo ezincinci, inani labakhenkethi lilonke lasasazwa kwicandelo ngalinye elijikeleze ukufakelwa kwenyukliya njengomlinganiselo wabantu abasisigxina kwelo candelo. Umlinganiselo wabakhenkethi ngabantu abasisigxina abangama-0.0365 wasetyenziswa kwicandelo ngalinye kunyaka othile.

Inani lilonke labakhenkethi abakwi-50 km radius ejikeleze indawo yaseThyspunt ngalo naluphi na usuku kwinyanga ekwindawo ephezulu (oko kukuthi ngoDisemba) liqikelelwe (uqikelelo oluphezulu) ukuba malunga:

- Abakhenkethi abayi-4 524 ngo-2024;
- Abakhenkethi abayi-5 521 ngo-2036;

- Abakhenkethi abayi-8 734 ngo-2096;
- Abakhenkethi abayi-8 743 ngo-2130.

5.3.4.1.4 Ukusasazwa kwabantu okuqikelelweyo

i) Abemi abasisigxina

a) Inani labantu eliqikelelweyo

Ngokuhambelana nemigaqo efanelekileyo yophuhliso lofakelo lwenyukliya, kufuneka kwenziwe uqikelelo lwabemi ukuze kuphile ubomi obude bofakelo. Ngenxa yesi sizathu, ukukhula kwabemi ngaphakathi kwerediyasi engama-50 km ejikeleze indawo bekuqikelelwe ukuya kuthi ga kunyaka ka-2096.

Uqikelelo lwabemi ngaphakathi kwerediyasi engama-50 km ejikeleze ufakelo lwenyukliya lubonisa, malunga:

- Abantu abayi-123 970 ngo-2024 (jonga Umfanekiso 30);
- Abantu abayi-156 010 ngo-2036;
- Abantu abayi-245 320 ngo-2096;
- Abantu abayi-245 034 ngo-2130 (jonga Umfanekiso 31).

Ngokusekelwe kule datha ikhankanyiweyo apha ngasentla, ukusasazwa kwenani lilonke labemi kuqikelelwe kwisithuba seminyaka elishumi ukusuka ngo-2024 ukuya ku-2130 ngaphakathi kwe-50 km ukusuka kwindawo yokufakelwa kwenyukliya. Uqikelelo lwabemi lilonke ngaphakathi kwe-50 km radius ejikeleze indawo yokufakelwa kwenyukliya lubonisa, phakathi kwezinye izinto, malunga:

- Abantu abayi-128 490 ngo-2024 (jonga Umfanekiso 32);
- Abantu abayi-161 523 ngo-2036;
- Abantu abayi-254 042 ngo-2096;
- Abantu abayi-253 772 ngo-2130 **UMFANEKISO 33:** Ubuninzi Benani Elipheleleyo Labemi Bendawo (2130)).

Inani lilonke lamanani abantu abaqikelelweyo ngo-2024, 2036, 2096 kunye no-2130 malunga nee-annuli ezahlukeneyo ezikumgama we-50 km ukusuka kwindawo ephakathi yile ilandelayo:

- Irediyasi eyi-6.5 km

I-Oyster Bay enabemi abamalunga nama-872 ngo-2024, malunga nabantu abangama-990 ngo-2036, malunga nabantu abayi-1 221 ngo-2096, kunye nabantu abamalunga ne-1 187 ngo-2130, yeyona ndawo yokuhlala ikwi-6.5 km ukusuka kwindawo leyo.

Inani labantu abahlanganisiweyo ngaphakathi kwe-6.5 km radius liqikelelwa ukuba limalunga nabantu abayi-1 162 ngo-2024, abantu abayi-1 496 ngo-2036, abantu abayi-1 803 ngo-2096 kunye nabantu abayi-1 730 ngo-2130.

- Irediyasi eyi-16 km

Idolophu yaseSt. Francis Bay yeyona ndawo inabantu abaninzi abahlala kuyo ngaphakathi kwe-16 km radius kwaye kuqikelelwa ukuba inabemi abayi-6 632 ngo-2024, abantu abayi-8 571 ngo-2036, abantu abayi-12 875 ngo-2096 kunye nabantu abayi-12 519 ngo-2130.

Inani labantu abadibeneyo ngaphakathi kwe-16 km radius liqikelelwa ukuba ngabantu abayi-15 463 ngo-2024, abantu abayi-21 803 ngo-2036, abantu abayi-33 926 ngo-2096 kunye nabantu abayi-33 628 ngo-2130.

- Irediyasi engama-35 km

Idolophu zaseHumansdorp/KwaNomzamo kunye neJeffreys Bay zezona ndawo zokuhlala zinkulu ngaphakathi kwi-radius engama-35 km. Inani labantu baseHumansdorp/KwaNomzamo liqikelelwa ukuba lingama-38 594 ngo-2024, abantu abangama-50 149 ngo-2036, abantu abangama-94 899 ngo-2096 kunye nabantu abangama-97 791 ngo-2130.

Inani labantu baseJeffreys Bay liqikelelwa ukuba lingama-35 344 ngo-2024, abantu abangama-44 782 ngo-2036, abantu abangama-69 239 ngo-2096, kunye nabantu abangama-67 972 ngo-2130.

Inani labantu eliqokelelweyo ngaphakathi kwe-35 km radius liqikelelwa ukuba lingama-88 633 ngo-2024, abantu abangama-116 117 ngo-2036, abantu abangama-191 536 ngo-2096 kunye nabantu abangama-192 058 ngo-2130.

- Irediyasi engama-50 km

Idolophu zaseHumansdorp/KwaNomzamo kunye neJeffreys Bay zezona ndawo zokuhlala zinkulu ngaphakathi kwerediyasi engama-50 km. Ezinye iindawo zokuhlala ezinkulu ngaphakathi kwerediyasi engama-50 km yiHankey, iSt. Francis Bay, iPatensie kunye neKareedouw. Inani lilonke labantu baseHankey liqikelelwa ukuba li-14 937 ngo-2024, abantu abayi-17 875 ngo-2036, abantu abayi-27 824 ngo-2096 kunye nabantu abayi-27 779 ngo-2130. Inani lilonke labantu basePatensie liqikelelwa ukuba li-6 743 ngo-2024, abantu abayi-7 525 ngo-2036, abantu abayi-9 933 ngo-2096 kunye nabantu abayi-9 659 ngo-2130.

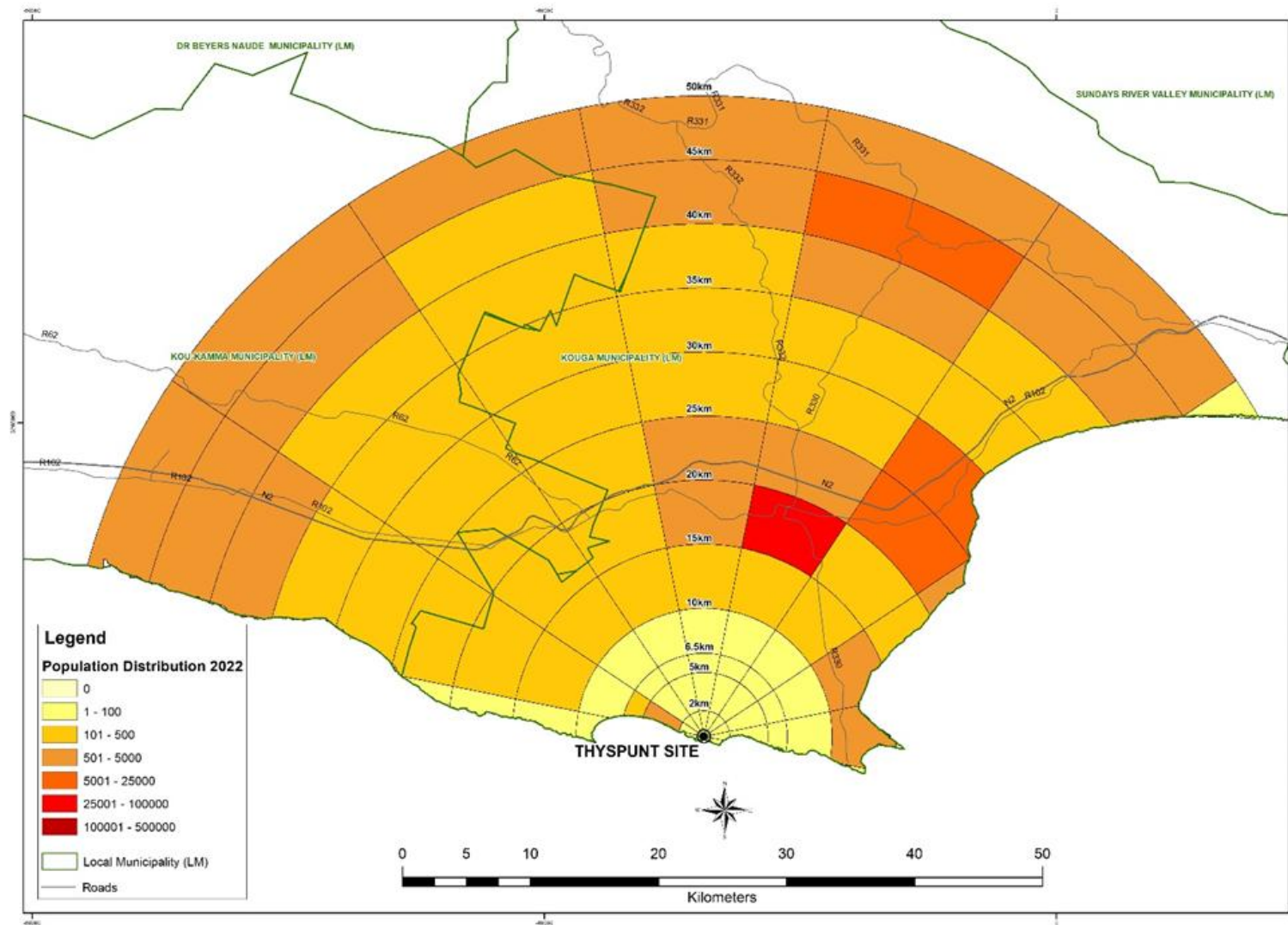
Inani lilonke labantu baseKareedouw liqikelelwa ukuba li-5 973 ngo-2024, abantu abayi-6 743 ngo-2036, abantu abayi-8 667 ngo-2096 kunye nabantu abayi-8 587 ngo-2130.

Inani lilonke labantu abakwi-50 km radius liqikelelwa ukuba li-128 490 ngo-2024, Abantu abayi-161 523 ngo-2036, abantu abayi-254 042 ngo-2096 kunye nabantu abayi-253 772 ngo-2130.

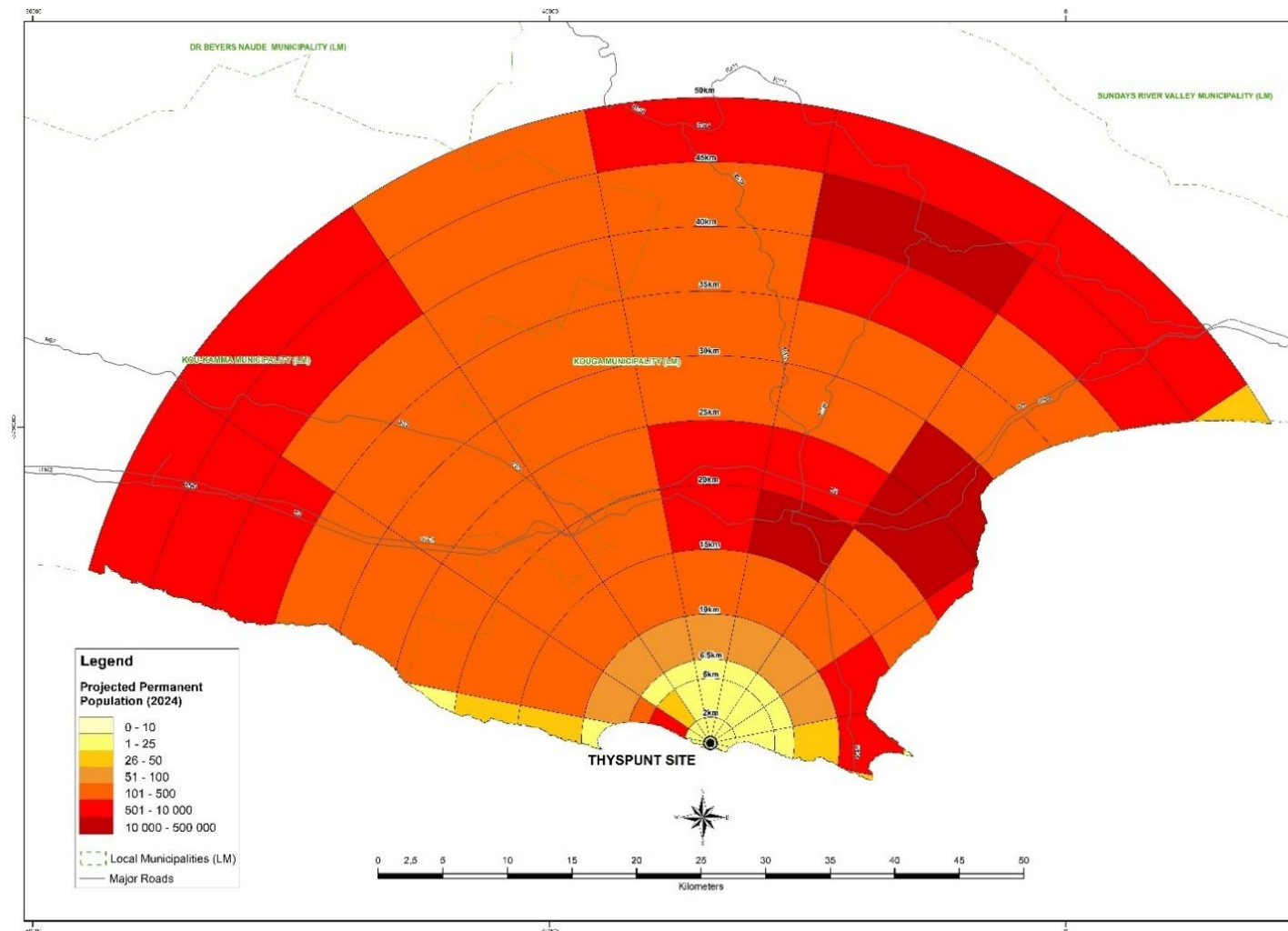
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Akunakwenzeka ukuba iziko labantu abangama-25 000 nangaphezulu likhule ngaphakathi kwe-6,5 km ukusuka kwindawo leyo ngexesha lokufakwa kwenyukliya. Ngenxa yokuba kunokwenzeka ukuba ukufakwa kwenyukliya kungenziwa kwindawo leyo, ukwandiswa okungakumbi kwe-Oyster Bay/Umzamawethu kufuneka kuthintelwe.

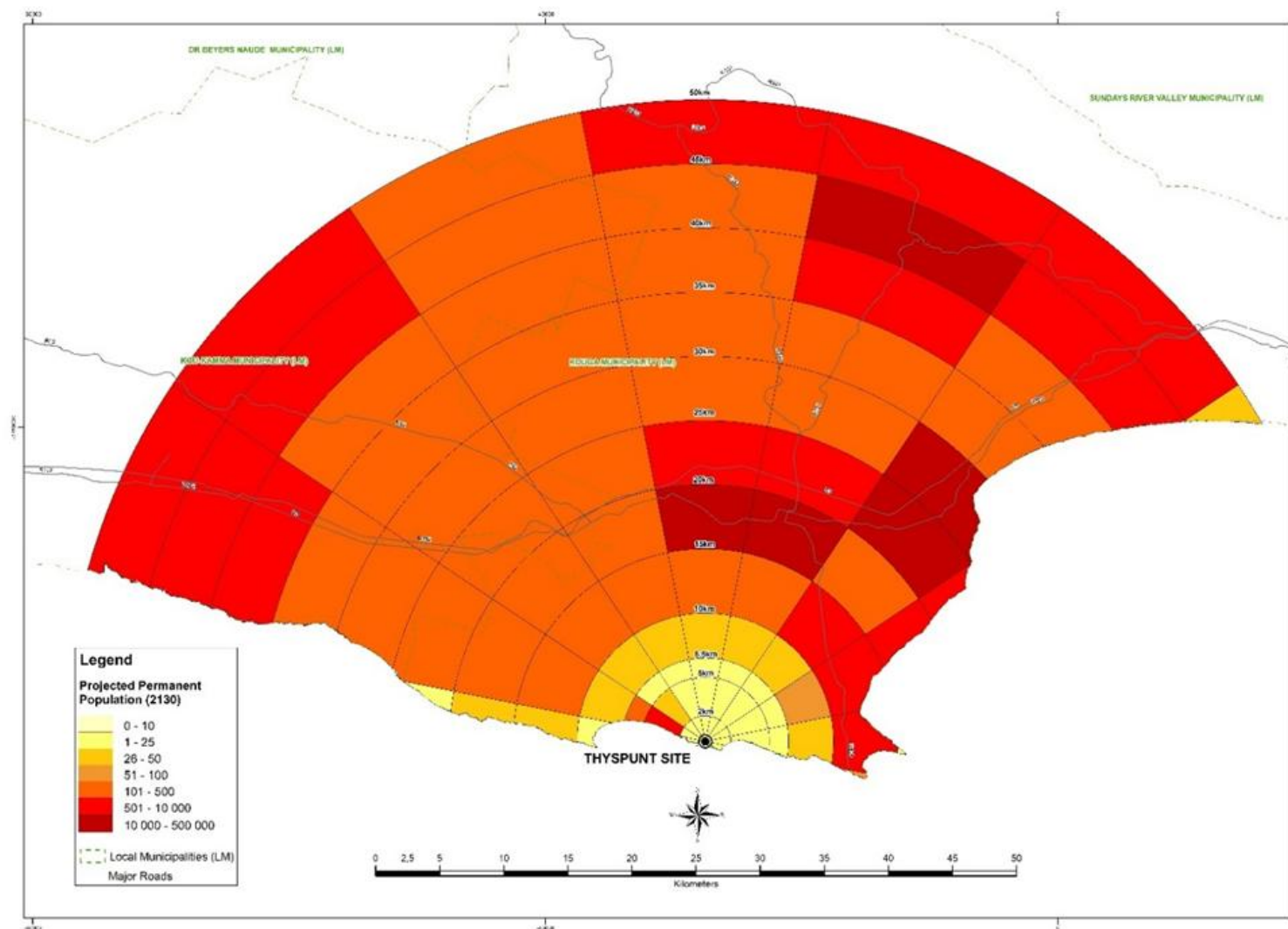
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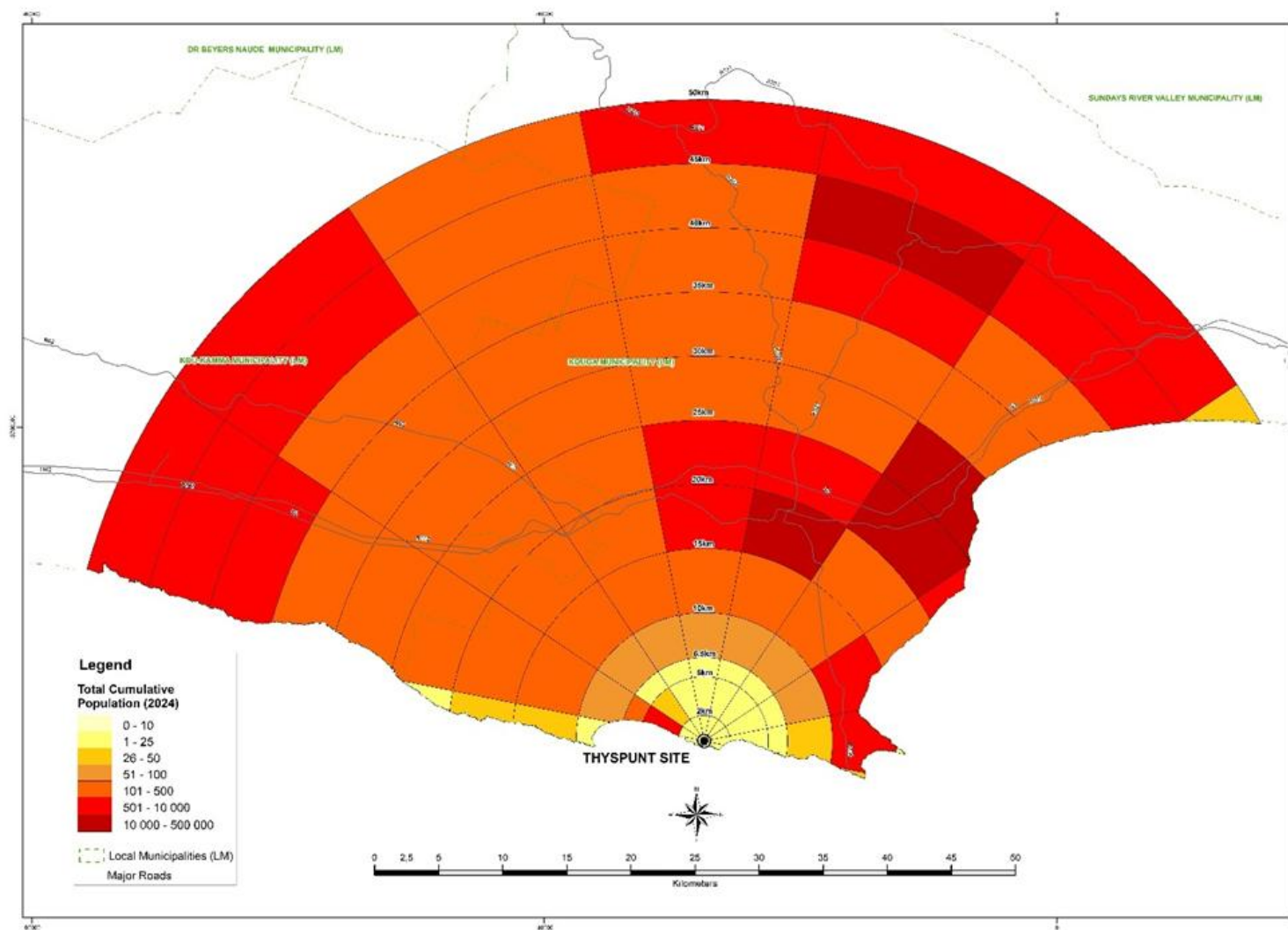
Umfanekiso 29: Ukusasazwa kwabantu ngaphakathi komgama we-5 km ujikeleze indawo yaseThyspunt (igradi yeradiyo engama-22,5°) ukuya kuthi ga kwi-50 km (2022)



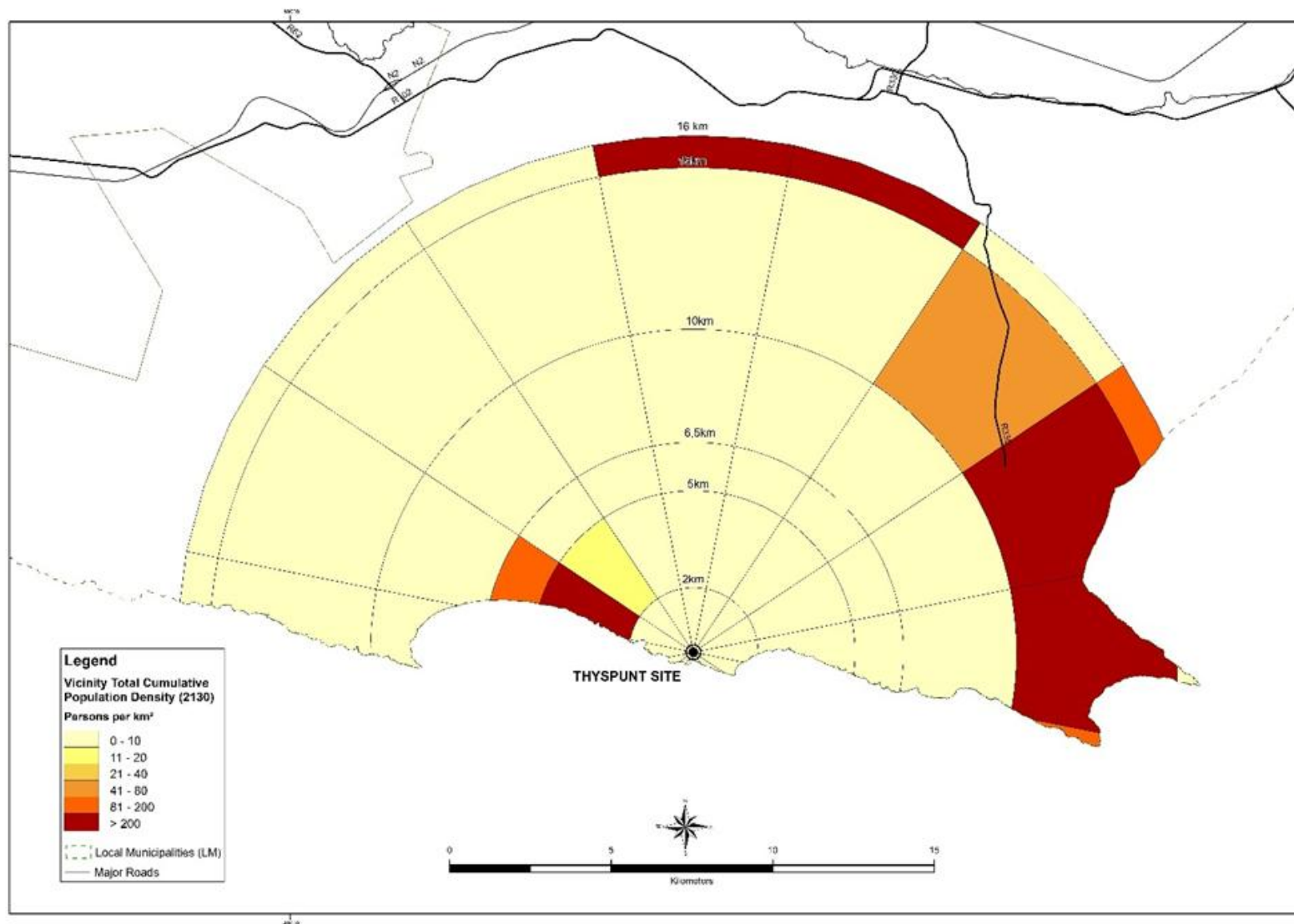
Umfanekiso 30: Inani labantu eliqikelelwayo elihlala lihleli ngaphakathi komgama we-5 km ujikeleze indawo yaseThyspunt (igradi yeradial ye-22.5 degrees) ukuya kuthi ga kwi-50 km (2024)



Umfanekiso 31: Inani labantu eliqikelelwayo elihlala lihleli ngaphakathi komgama we-5 km ujikeleze indawo yaseThyspunt (igradi yeradial ye-22.5 degrees) ukuya kuthi ga kwi-50 km (2130)



Umfanekiso 32: Inani lilonke labantu abaqokelelweyo ngaphakathi komgama we-5 km i-annuli ejikeleze indawo yaseThyspunt (igridi yeradial ye-22,5 degrees) ukuya kuthi ga kwi-50 km (2024)



Umfanekiso 33: Ubuninzi Benani Elipheleleyo Labemi Bendawo (2130)

5.3.4.2 Ukusetyenziswa Komhlaba Namanzi

Ukusetyenziswa komhlaba namanzi kwaphawulwa ukuze kuvavanywe iziphumo ezinokubakho zokufakelwa kwenyukliya okunokwenzeka kulo mmandla, ngakumbi ngeenjongo zokulungiselela izicwangciso zengxamiseko. Uphando lugubungele umhlaba kunye nemithombo yamanzi esetyenziswa luluntu okanye enokuba yindawo yokuhlala yezinto eziphilayo kwikhonkco lokutya.

Umandla wendawo ubonakala kakhulu kwiindawo zendalo (69.9 ekhulwini). Ulimo lwenza ama-24.0 ekhulwini lomhlaba wengingqi. Amanqanaba aphantsi kakhulu omhlaba wedolophu akhona (2.1 ekhulwini), kunye nophuhliso oluphantsi lwemizi-mveliso.

Ulimo lwenzeka kulo lonke ummandla wengingqi, ikakhulu ecaleni kwemilambo nakwiindawo ezisemacaleni onxweme. Ukulinywa kweziqhamo kunye nemifuno kugxile eHankey nasePatensie, apho inani elikhulu lee-citrus likhuliswa kwaye lithunyelwa kwamanye amazwe kulo mmandla.

Ukulima ubisi okubalulekileyo kwenzeka kwiindawo ezisemacaleni onxweme ezijikeleze indawo.

Kukho iidolophu ezininzi zokuzonwabisa ezikufutshane nendawo. Indawo yokuhlala yasezidolophini e-Oyster Bay (kuquka indawo yokuhlala engekho sesikweni yase-Umzamowethu) ingaphantsi kwe-5 km entshona yendawo, kwaye iCape St. Francis kunye neSt. Francis Bay zikwi-10.8 km empuma yendawo, iParadise Beach (18 km empuma-mpuma), i-Aston Bay (22 km empuma-mpuma), iPellrus (23 km empuma-mpuma) kunye neGamtoos Mouth (41 km empuma-mpuma). Ezi dolophu ziselunxwemeni zibalulekile kwaye zizinzile kwiindawo zokhenketho (jonga Umfanekiso 34).

Ezinye iindawo zokuhlala zasezidolophini ezikwi-20 km radius yendawo ziquka iHumansdorp (17.3 km emantla-mpuma), iziko leshishini lokukhanya kunye nemisebenzi yezolimo yesithili esibanzi. IJeffreys Bay (25 km emantla-mpuma) yidolophu yokuphumla eselunxwemeni eyaziwa ngamanxweme ayo kunye namaza okudada, kuquka iSuper Tubes edumileyo kwihlabathi liphela. Ikwabonelela ngeentlobo ngeentlobo zemisebenzi yokuzonwabisa, kubandakanya ukuntywila kwi-scuba, ukuntywila kwi-skydiving kunye nequad biking. Iidolophu ezincinci ezininzi zisasazeke kulo lonke elasemaphandleni, kuquka iClarkson (32 km entshona-ntshona), iHankey (38 km emantla-mpuma), iKareedouw (45 km emantla-ntshona), iLoerie (46 km emantla-mpuma) kunye nePatensie (49 km emantla-mpuma).

Isixeko esikufutshane nesiza yiGqeberha ekwiikhilomitha ezingama-80 emantla-mpuma (oko kukuthi, ngaphandle kwengingqi yesiza).

Ukwandiswa okuncinci kweedolophu ezikwiikhilomitha ezili-16 ukusuka kwindawo kucingelwa kwinqanaba likarhulumente wasekhaya. Iindawo ezinkulu zokukhula ezilindelweyo zicwangciselwe kwinqanaba lesicwangciso sikamasipala kwiindawo zokuhlala zaseHumansdorp naseJeffreys Bay.

Phantse i-1.4% yommandla ithwala imithombo yamanzi angaphezulu. La manzi asetyenziselwa ukunkcenkceshela kunye nokunikezelwa kwamanzi okusela ngaphakathi kwendawo yesiza. Inxalenye enkulu yawo idluliselwa kwiNelson Mandela Bay Metropolitan Municipality (NMBM) nge-Algoa Water Supply System (AWSS). Amanzi angaphantsi komhlaba sisixhobo samanzi esibalulekileyo kwiidolophu eziselunxwemeni nakwinxalenye esezantsi yommandla. Iidolophu ezixhomekeke kwimithombo yamanzi angaphantsi komhlaba ukuze zithole amanzi ongezelelweyo okusela (oko kukuthi, ukongeza kumanzi afunyanwa nge-AWSS), ziquka iHumansdorp, iSt. Francis Bay, iCape St. Francis, iOyster Bay, kunye neJeffreys Bay. I-aquifer ephambili esetyenziswayo iquka ilitye lesanti eliqhekekileyo leTable Mountain Group Aquifer.

Lilonke, i-AWSS iswele ngenxa yokwabiwa kakhulu kwamanzi, kunye nokuphunyezwa kancinci kokungenelela ukuze kwahlulwe ukunikezelwa kwamanzi kunye nokunciphisa iimfuno zamanzi.

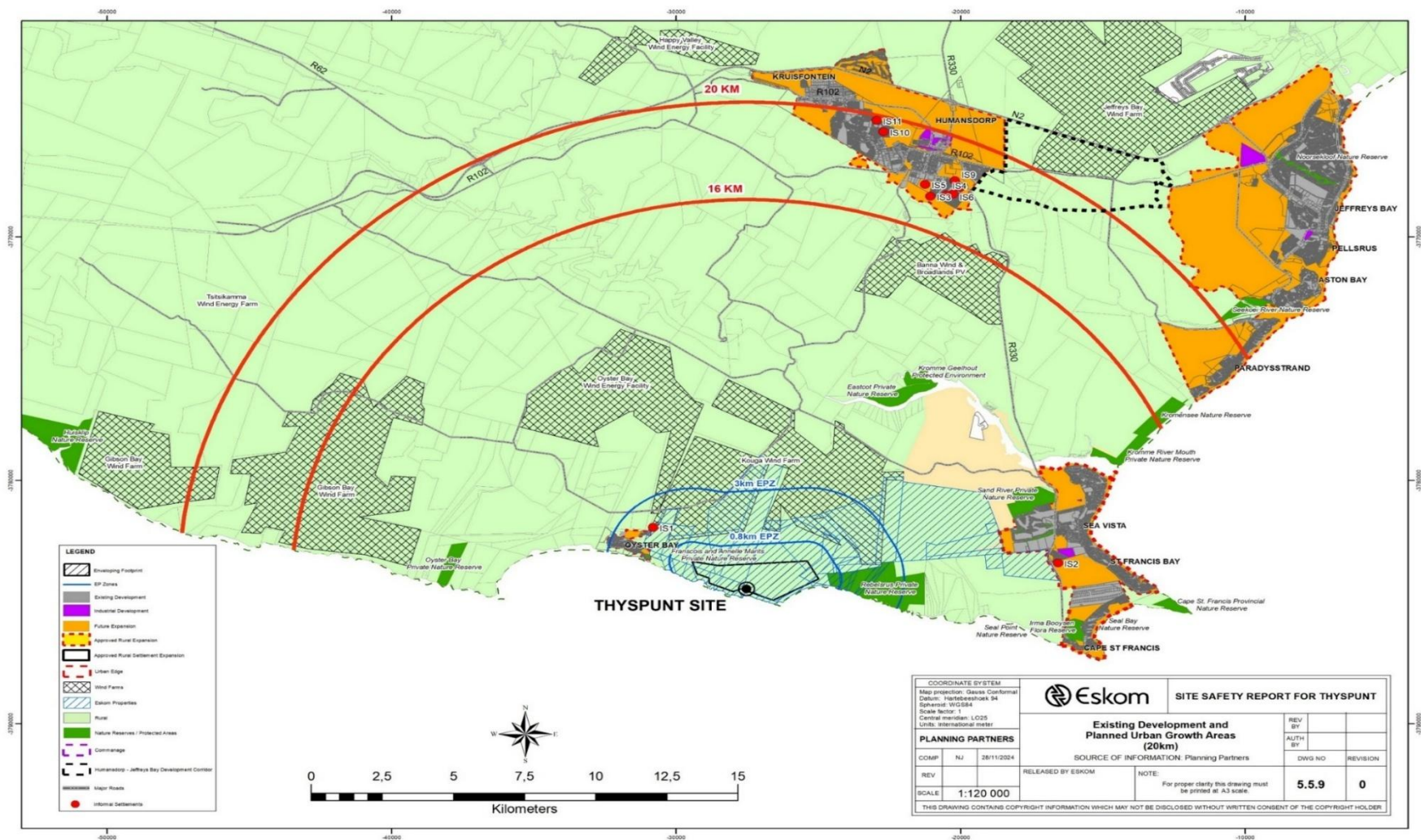
UMasipala waseKouga ufikelele ngempumelelo kumda wokwabiwa kwawo yi-AWSS. Ukukhula okungakumbi kwiimfuno zamanzi zikamasipala kufuneka kuhlangatyezwane nophuhliso lwezixhobo zamanzi ezintsha nguMasipala waseKouga (umz. izixhobo zamanzi angaphantsi komhlaba).

Iidolophu ezikunxweme olukufutshane nendawo zinamava okutshintshatshintsha kwexesha lokusetyenziswa kwamanzi ngenxa yenani elikhulu lamakhaya esibini ahlala abantu ngamaxesha eeholide, kunye nenani elikhulu labakhenkethi abatyelela indawo ngexesha leeholide zeKrisimesi nezePasika.

Amanzi asetyenziselwa ukunkcenkceshela kumhlaba wezolimo afunyanwa kwimilambo ekule ndawo kunye namadama amakhulu amathathu, angamadama aseKouga, eChurchill, naseMpofu. Amadama amancinci amaninzi kunye neendawo zokukhupha amanzi angaphantsi komhlaba nazo zisetyenziselwa ukunkcenkceshela.

Ukusasazwa komhlaba ngokubanzi kule ndawo kulindeleke ukuba kuhlale kuzinzile ngexesha lokufakwa kwenyukliya, ngakumbi ngokubhekiselele kwiindawo zokuhlala zasezidolophini ezikufutshane nendawo.

Iindawo ezinkulu zendawo ziboniswe ngeenjongo zokulondoloza. Ngenxa yokubaluleka kwezolimo kunye nemizamo eqhubekayo yokulondoloza, kunokulindeleka ukuba ukusetyenziswa komhlaba kwindawo ekufutshane akuyi kuba notshintsho olukhulu kwixesha elizayo. Oku kuthathela ingqalelo imida yophuhliso lwedolophu kule ndawo. Isikhokelo soPhuhliso lweNdawo saseKouga sibonisa ukuba iimfuno zophuhliso zexesha elizayo kule ndawo kufuneka zijoliswe ekukhuseleni izixhobo zolimo nezendalo ngokusebenzisa imida yedolophu. Apho kuvela khona izindululo ezinkulu zophuhliso (umz. indlela entsha yophuhliso olugxile kwimizi-mveliso ecaleni kwe-R102 phakathi kweHumansdorp neJeffreys Bay), ezi zenzeka ngaphandle kwendawo eyi-16 km.



Umfanekiso 34: Uphuhliso olukhoyo kunye neendawo ezicwangcisiweyo zokukhula kwezixeko (20 km)

5.3.4.3 Ukusetyenziswa koLwandle olukufutshane

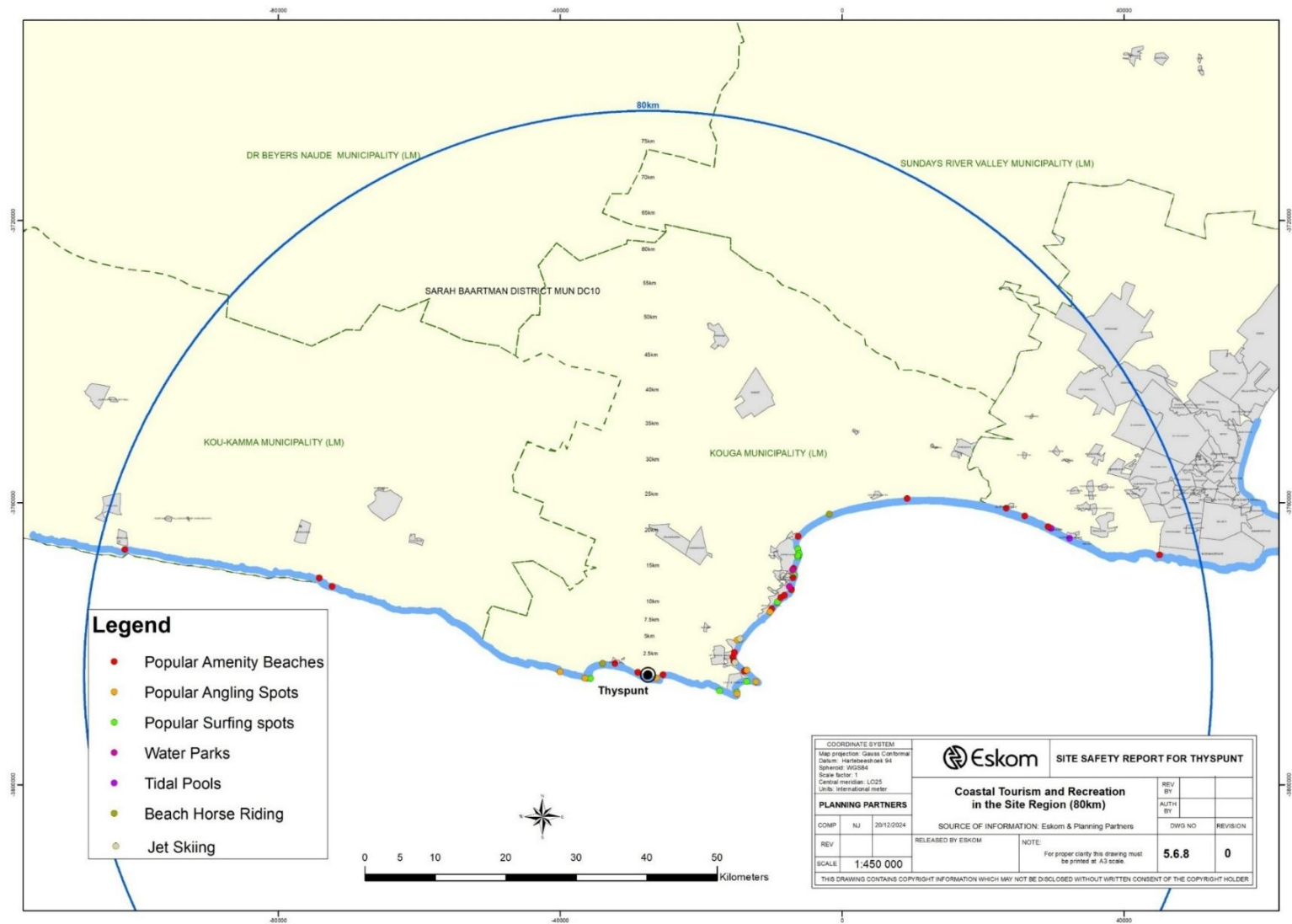
Unxweme lwengingqi olusemantla esiza luphawulwa ngamatye avulekileyo, unxweme oluxubeneyo kunye nonxweme olunesanti. Ukusetyenziswa komhlaba kolu nxweme ikakhulu kulondolozo lwendalo kunye nolwasemaphandleni, ngaphandle kweedolophu ezikunxweme i-Oubosstrand (51.60 km entshona-emanthla-ntshona), i-Eersterivierstrand (49.74 km entshona-emanthla-ntshona) kunye ne-Oyster Bay kunye neCape St. Francis, iSt. Francis Bay, iParadise Beach, i-Aston Bay, iMarina Martinique (24.1 km empuma-emanthla-ntshona) kunye neJeffreys Bay enkulu, iBlue Horizon Bay (59.34 km empuma-emanthla-mpuma), iBeach View (65.38 km empuma-emanthla-mpuma), iSea View (67.96 km empuma-emanthla-mpuma), iKini Bay (69.61 km emantla-mpuma) kunye neSardinia Bay (81.13 km empuma-emanthla-mpuma).

Kukho inani leeNdawo eziKhuselweyo zaseLwandle (ii-MPA) kummandla wendawo, oko kukuthi, i-Tsitsikamma MPA, i-Sardinia Bay MPA kunye ne-Gqeberha Corals MPA.

Le ndawo ikwiNdawo yoLwandle oluKhethekileyo ebhengezwe ngokweSivumelwano saMazwe ngaMazwe soThintelo loNgcoliseko lwaseLwandle oluvela kwiinqanawa zowama-1973, njengoko siguqulwe yiProtocol yowama-1978 (i-MARPOL), egxile ekukhuseleni okusingqongileyo kolwandle kunye nezixhobo kungcoliseko lweoyile. Ulawulo lokusetyenziswa kolwandle kunye nolwandle ngaphakathi kwendawo yendawo luphantsi koMthetho weeNdawo zoLwandle, ka-1995, uMthetho woLwandle oluNxweme, ka-1935 kunye noMthetho weZixhobo zoBomi boLwandle, ka-1998.

Imisebenzi ephambili enxulumene nokusingqongileyo kolwandle kunye nolwandle inxulunyaniswa neempawu zonxweme kwaye ibandakanya ukuloba, ukuqokelela ukutya, imisebenzi yokuzonwabisa kunye nokhenketho kunye nokucubungula iimveliso zeentlanzi.

Imisebenzi yokuloba ibandakanya ukuloba ngorhwebo, ukuloba okuncinci kunye nokuloba ngokuzonwabisa. Iintlobo zeentlanzi ezifana ne-squid, i-south coast rock lobster, kunye neentlanzi zivunwa ngorhwebo kuloo ndawo. Ukuloba ngokuzonwabisa nako kuyathandwa kwaye kwenziwa kwiindawo ezifikelelekayo zonxweme kunye neenqanawa zokutyibiliza. Ummandla wonxweme ojikeleze indawo yindawo ethandwayo yokhenketho kwaye uquka iidolophu zokuzonwabisa zaselunxwemeni zaseOyster Bay, eSt. Francis Bay, naseCape St. Francis. Imisebenzi yokuzonwabisa neyokhenketho eyenzeka elunxwemeni ibandakanya ukudada, ukutyibiliza, ukutyibiliza ngekite, ukukhwela iinqanawa, ukukhwela isanti kunye nokuloba ngokuzonwabisa (jonga Umfanekiso 35)



Umfanekiso 35: Ukhenketho nokuzonwabisa elunxwemeni (80 km)

5.3.4.4 Izicwangciso zoPhuhliso lweSithili

lipiani ezahlukeneyo zecebo kunye nemigaqo-nkqubo yaqokelelwa kwindawo ebanzi apho indawo ikwisigxina kuyo. Imigaqo ye-Kouga Spatial Planning and Land Use Management By-Laws, 2015 [65] kunye ne-Koukamma Spatial Planning and Land Use Management By-Laws, 2016 [67] icacisa ukuba kufuneka kubhalwe uhlaka lwentlalontle yokuphuhlisa indawo kumasipala wase Kouga nakumasipala wase Koukamma, ngokwahlukeneyo.

Imisebenzi yendawo ejongwe phambili (ephawula ukusasazeka kwabemi) ichaphazeleka kakhulu lulawulo lokusetyenziswa komhlaba kunye nolawulo lwendawo. Ke ngoko, imisebenzi yexesha elizayo iboniswa ngokuxoxa ngeendlela nendlela zokucwangcisa indawo ezamkelwe ngurhulumente weekomkhulu zaseKouga naseKoukamma, umzekelo iKouga Spatial Development Framework, 2021 (Kouga SDF)[66] kunye neKoukamma Spatial Development Framework, 2023 (Koukamma SDF) [68].

a) Umgca weNkqubo yoPhuhliso loMmandla waseKouga (2021)

Indawo ikwisithuba sobukhosi beDolophu yaseKouga. I-Kouga SDF [66] yiyindibano ejolise ekuchaphazeleni ukusasazwa kwemisebenzi yomhlaba yangoku neyoza kwikamva kulo mmandla weDolophu ukuze kuphumelele umbono, iinjongo kunye neenjongo zoMqulu woPhuhliso oDibeneyo (IDP). Ngelixa i-IDP ilungiselelwe ixesha leminyaka emihlanu, i-SDF inxesha elide leminyaka engama-30, ngaloo ndlela inikezela umqondiso wesikhathi eside se-IDP.

Injongo ye-SDF kukuba kuqinisekise ukuba ukukhula nophuhliso lwexesha elizayo akuyi kubangela ukujikeleza kwezindawo zokuhlala ezisezantsi kwaye kungonakalisi inkqubo yezendalo kunye nezixhobo zasemaphandleni, kwaye kuyaqhubeka nokwahlulahlula ngokwendawo kwabantu kwixesha elidlulileyo.

Ngokuhambelana nombono, i-SDF igcina inxalenye enkulu yendawo ukukhusela kunye nokulawula iindawo zendalo kunye nomhlaba wezolimo onexabiso eliphezulu. Ngaphandle kwemisebenzi engadliwayo kunye nokusetyenziswa komhlaba okuhlobene nokuveliswa kwezolimo kunye nenkqubo yezolimo, utshintsho olubalulekileyo ekusetyenzisweni komhlaba kwiindawo ezingezixeko alulindelekanga.

I-SDF icebisa uluhlu lwezindlu ezihlala abantu olusuka kwizikhululo zasendle zasendulo ukuya kwizixeko eziphambili zaseJeffreys Bay naseHumansdorp. Ezi zixeko zidibaniswe ngenethiwekhi ephелеleyo yeendlela zokuhamba ezisebenza zombini umsebenzi wokuhamba kunye nezothutho. Ezi ndlela nazo zibalulekile ngokwemibono yokhenketho (jonga Umfanekiso 36 ngezantsi).

'I-triangle yolwakhiwo' lweJeffreys Bay, Humansdorp kunye neSt. Francis Bay apho kucinezelwa khona kakhulu uphuhliso, kunye neebhondi zesibini zaseHankey nasePatensie, ziyachongwa ukuze kutyalo imali ngokukodwa kwiziseko zophuhliso kunye nolwakhiwo lwezakhiwo zabantu. Njengoko icandelo

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lezoLimo laseGamtoos lilindeleke ukuba lande kakhulu, isidingo sezindlu zabantu kunye nezixhobo zalo kwindawo siza kuqhubeka nokukhula. I-SDF ichonga i-Andrieskraal njengendawo enokuthi isetyenziswe ekusungulweni kwesixeko esitsha sasemaphandleni ukulungiselela ezi mfuno.

Imiphetho yedolophu neyemaphandleni ichaziwe kuyo yonke imimandla yokuhlala ukukhusela izixhobo ezixabisekileyo kwezolimo, imvelo kunye namasiko kwaye kuvumeleke uphuhliso lweendawo zokuhlala ezizinzileyo.

Ukuxhasa isicwangciso somzila, iindawo eziphambili, ezesibini nezemaphandleni ezikhoyo kufuneka zomeleziwe ngokugcwala komhlaba kunye nophuhliso olunomxholo ophezulu. Ukwanda kunye notyalo-mali kufuneka kugxile kwiindawo eziphambili zeJeffreys Bay naseHumansdorp. Iindawo ezesibini ezifana neHankey, iPatensie kunye neSt. Francis Bay kufuneka zifezekise imisebenzi yokuhanjiswa kweenkonzo ezisisiseko kunye nezikhumbuzo kwabantu abakwiindawo ezisemaphandleni. Ukukhula okulinganiselweyo kunye notyalo-mali kuyacetyiswa kwiindawo ezisemaphandleni ezifana neLoerie kunye neOyster Bay. I-SDF ithi ukusungulwa kweendawo ezintsha ezisemaphandleni kufuneka kucetyiswe ngononophelo. I-Andrieskraal ichongiwe njengenye indawo entsha yemaphandleni ukwamkela ezinye zeenkqubo zokukhula kwixesha elizayo kwiGamtoos Valley. Uphuhliso lwemizila kufuneka luxhase ukuhanjiswa kweenkonzo, ifom yedolophu ethe tyaba, kunye nemixube ephezulu ukuqinisekisa ukuzinzileyo.

Malunga neemeko zokuhamba, i-SDF iphakamisa ukuba inethiwekhi ekhoyo, enefreeway ye-N2 njengesona siseko siphambili, igcinwe kwaye iqiniswe ngokuphuculwa kunye nolondolozo rhoqo ukuqinisekisa uphuhliso kunye nokukhula koqoqosho. Ukungaphazanyiseki kweendlela zokuhamba kufanele kugcinwe ngokuhlolisisa ngokweenkcukacha izindululo zokufikelela ngexesha lezicelo zophuhliso.

Kuphakanyiswa ukuba kube nendlela yophuhliso ecaleni koMgangatho weR102 kunye neN2 Freeway phakathi kweJeffreys Bay kunye neHumansdorp. Oku kuhloswe ngako ukufaka amashishini orhwebo, imizi-mveliso, amashishini aphezulu kunye namashishini ahambelana nezolimo kunye neendawo zokuhambisa.

I-SDF iphakamisa icebo lesakhelo lomqolo wokuqala e-Oyster Bay (jonga Umfanekiso 37 ongezantsi). Isakhelo siceba amathuba amancinci okhenketho kunye neendawo yokuhlala yabasebenzi bemilambo. Zininzi iindawo ezingasetyenziswanga ezifumanekayo kulo msebenzi. Ngokwe-SDF, umoya woluntu olusemaphandleni kunye nobuncinci bombutho kufuneka bugcinwe, kugxilwe ekuhlenganiseni idolophu yaseOyster Bay kunye no-Umzamowethu. Umda wedolophu ochaziweyo ukhethe ukuvimbela iindawo ezibucayi zolwandle kunye neendawo ezibalulekileyo zokwahluka kwezinto eziphilayo, umhlaba

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wezolimo kunye nomhlaba ongafakwanga kwinkqubela-phambili ekuphuhliseni. Ukuphuhliswa kwezindlu kwixesha elizayo kuxhomekeke ku “qinisekiso oluvela kwa-Eskom ngokwepolisi yeThyspunt”.

Malunga neThyspunt, iSDF ithi oku kulandelayo:

"Indawo yeThyspunt, entshona yeCape St. Francis sele ithengiwe yi-ESKOM ngenjongo yokuba mhlawumbi ingasetyenziswa kwixesha elizayo ukwenza umbane. Ngenxa yoko, iKouga Coast Sub-Regional Structure Plan yahlaziywa ngokusekelwe ekufuneka kugcinwe ukusebenza kakuhle kwindawo yeThyspunt ukuze mhlawumbi isetyenziswe kwisizukulwana sombane esizayo.

Malunga nendawo yeThyspunt, ezi migaqo yoxinzelelo lomhlaba ziyasebenza:

- *Ukuqinisekisa ukusebenza kakuhle kwindawo yeThyspunt kwisizukulwana sombane esizayo, uphuhliso lwe ndawo ezikufutshane kufuneka lulawulwe ngononophelo.*
- *Ukwanda kweedolophu zaseOyster Bay naseUmzamowethu, okungaphakathi kwindawo ye-0 - 5 km akufuneki kuvunyelwe.*
- *Ukubonelela ngesikolo esincinci (esingenalo i-hostel) esinokunceda abantwana bendawo kunokuxhaswa eOyster Bay.*
- *Ukusetyenziswa komhlaba ngokwemiqathango yezemfundo njengentolongo, iindawo zokuhlala zabantu abadala kunye nezibhedlele ezingenza kube nokuxinana kwabantu abahlala phaya akufuneki kukhiwe ngaphakathi kwe-16 km ukusuka kwindawo yeThyspunt, ngenxa yobunzima obunokwenzeka bokuphuma.*
- *Akuyi kuvunyelwa kwakhiwe izityalo ezintsha zokucubungula ukutya ngaphakathi kwi-16 km.*
- *Imisebenzi yezolimo kufuneka ilandelwe ngaphakathi kwe-16 km."*

Uhlolo oluncinci lwe-SDF kufuneka lwenziwe minyaka yonke, ngelixa uhlolo olukhulu/oluququzelelwe kabusha kufuneka lwenziwe yonke iminyaka emihlanu. Ezi uhlolo kufuneka zihambelane ne-IDP kunye nenkqubo yohlalutyo kunye nolungiso lomgca wesabelomali.

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Umfanekiso 36: Umgao-nkqubo wophuhliso lwendawo eKouga



Umfanekiso 37: Icebo lwesakhelo se-Oyster bay

b) Umnqophiso weNkqubo yoPhuhliso lweSithuba saseKoukamma (2023) [68]

Umasipala waseKoukamma ulele kwiSithili soMphathiswa wezoLuntu saseSarah Baartman. IKareedouw sisikhululo solawulo kwaye inabemi abamalunga ne-12 ekhulwini yabanxi bephulo lonke lomasipala.

Ngokwe-SDF [67] umbono wesithuba saseKoukamma ulandelayo:

"IKoukamma yindawo yomasipala ehlanganiswe ngokupheleleyo ngaphakathi kwindawo enkulu kazwelonke nangendawo yesithili kwaye ekhusele kwaye ephuhlisa izibonelelo ngokulinganayo ukuxhasa ukukhula kwezentlalo kunye nokuphuhliswa koqoqosho ngaphakathi kwezixeko ezinxulumene kakuhle nakwiindawo zasemaphandleni."

Ukubonelela ngezindlu ezifanelekileyo kubemi bendawo yomasipala yenye yeenkqubo eziphambili kunye nezinto eziphambili kwi-SDF. Injongo kukuphucula kunye nokusemthethweni iindawo ezingekho sikweni ezikhoyo kunye nokukhuthaza ukusulwa kwezindlu ezingekho sikweni kunye/nangaphakathi kwezakhiwo eziphambili.

I-SDF icebisa ukunyusa ubuninzi kunye nokusondeza kwezixeko ezikhoyo njengemizamo yokukhokela uxinzelelo lwophuhliso ukunyuka kwamandla ngaphakathi kwiindawo ezikhoyo zokwakha. Iindawo ezikhoyo zokwakha kufuneka zisetshenziswe ngendlela esebenzayo kakhulu ukwamkela iimfuno zoluntu zokuphuhliswa okungaphezulu ngaphambi kokuba kucatshangelwe ukukhululwa kweendawo eziluhlaza okanye iindawo ezintsha zedolophu. Imida yesixeko esicebisa malunga nezixeko ivumela ukukhuselwa kwezibonelelo ezixabisekileyo kwaye yenza ukuba kufezekiswe ukucinezelwa kohlobo lwezidolophu olusebenzayo.

Njengoko uqoqosho lukamaspala luxhomekeke kusetyenziso lwalo lwezibonelelo zendalo, oko kukuthi, iindawo ezinkulu zobuhlaza obuquka iimfuno eziphambili zencasa-mhlaba kunye nomhlaba womsebenzi wezolimo onamandla, kufuneka kusetyenziswe ngendlela emelana nokusingqongileyo. Utshintsho olubanzi olweentlobo zezolimo oluholela kwiindlela zokuphila ezizinzileyo, ukukhulisa uqoqosho lwasekulelweni kunye nokuphuculwa kolungiso lomhlaba, ngoko ke kuyakhuthazwa.

I-SDF igcizelela izibonelelo zoqoqosho kunye namathuba okusekwa kweeprojekthi zolimo ezincinci njengoko inokunikela kakhulu kuphuhliso loqoqosho lwasekuhlaleni kwizil communities zasemaphandleni kwaye yenza amathuba kubalimi abanethemba. Ukulima okuncinci kunokusekwa kufuphi nezixeko nakwiindlela zokuhamba.

Ubuntu bendalo ephambili, inkcubeko kunye nomsebenzi, iindawo zonxweme noluntu kunye nolwandle kufuneka ukhuseleke ukuqinisekisa ukuba indawo ihlala iyindawo yezoqoqosho nezokuzonwabisa ezisungulwe kakuhle. Izibonelelo

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ezintsha zabakhenkethi kunye nezindawo zokungcebeleka zingasekwe kummandla wakumaphandleni.

Ukusetyenziswa okufanelekileyo kolwandle kufuneka kuqinisekiswa, oko kuthetha ukulinganisa ukhuseleko kunye nophuhliso kwaye kuqinisekiswa ukuba akukho phuhliso lutsha kolwandle olwenziweyo ngaphandle kokuba luzimele phantsi kolunye uphuhliso olukhoyo.

Iindawo ezikhoyo nezingaba nguqulelo lwezolimo nezolimo lwenkuni kufuneka zikhuselewe njengezindlu ezivelisayo, izithuthi zoqoqosho eziphambili kunye nomthombo wokhuseleko lokutya. Shushu ishishini elinqamlezileyo nelinxulumene nenkonzo lingamkelwa kwingingqi yasemaphandleni, ngokuba le ndawo yonke izimeleyo ngokupheleleyo, oko kukuthi ukwandiswa kwenethiwekhi yokuhanjiswa kwamachweba kamasipala akufuneki.

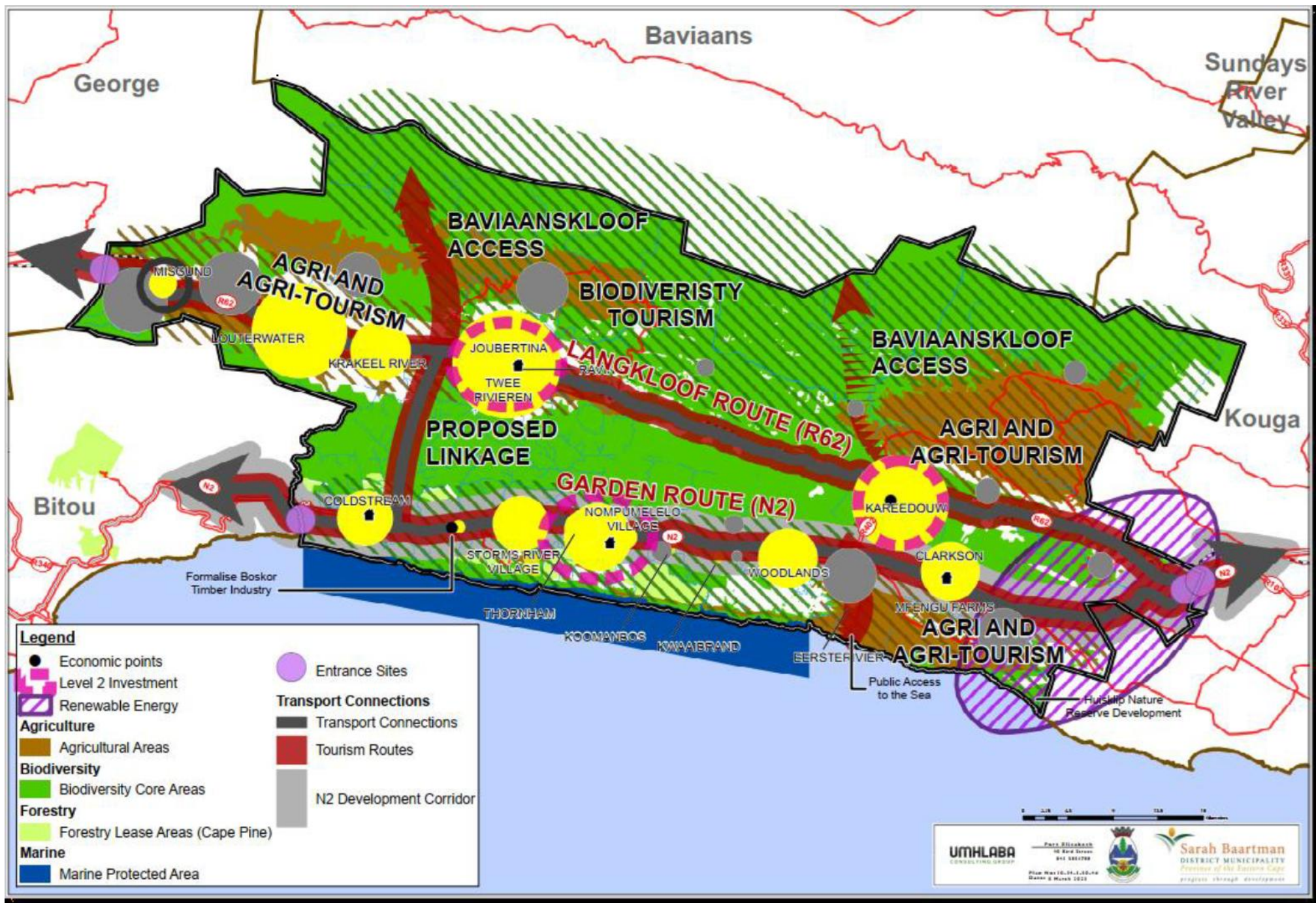
Ngokubanzi, ukuhlinzekwa kwezixhobo zoluntu kunye neenkonzo ezinxulumene nemiphakathi yasemaphandleni kufanele kwenzeke kwiindawo ezikhoyo zokuhlala.

Umxholo wenkalo eyanyelwayo udibanisa amacebo emigca yendawo eyahlukeneyo kunye neenkqubo zokusebenza ukubonisa injongo yendawo kamasipala (jonga kUmfanekiso 38).

c) Amanyathelo okuLawula uPhuhliso ejikeleza iiNkqubo zeNukileya

Uphuhliso kufuphi neenkqubo zenukileya kufuneka lulawulwe kwaye/okanye luhlolwe ngokubonisana neziphathimandla ezifanelekileyo zephondo kunye/okanye zezoluntu. Oku kwenziwa ukuqinisekisa ukuba akukho tshintsho lokusetyenziswa komhlaba olukhoyo olungabangela imisebenzi enokuba yingozi kwiinkqubo zenukileya, umzekelo, ukuvalelwa kwesithuba sentsebenziswano yezimboni ezingozi, okanye ezo zinokubangela impembelelo embi kucwangciso lweziganeko ezingxamisekileyo. Ezi mfuno kufuneka zifakwe kwi-SDFs nakwizikhokelo zokucwangcisa eziphambili. Kolu hlobo, nangona kuxeliwe ngasentla, inani lamanyathelo sele efakwe kwi-Kouga SDF

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Umfanekiso 38: Koukamma Spatial Development Framework

6 AMAVA OKUSEBENZA

6.1 Isikhululo Samandla Enyukliya saseKoeberg

I-Eskom inelungelo leLayisenisi yoFakelo lweNyukliya (uhlobo lwe-NIL-01 22) [31] yeSitishi saMandla seNyukliya saseKoeberg (eKoeberg), esineeyunithi ezimbini zereactor zamanzi ezine-930 MWe ezixineneyo.

Isityalo saqala ukusebenza kwezorhwebo ngo-1984, kwaye izifundo zokhuseleko zokuqala zathatha ubomi beminyaka engama-40. Iyunithi yoku-1 ifikelele kwiminyaka engama-40 yokusebenza kwezorhwebo ngoJulayi 2024 ngelixa iyunithi yesi-2 ifikelele kwiminyaka engama-40 ngoNovemba 2025. Zombini ezi Units zifumene iLayisenisi yoFakelo lweNyukliya ukwandisa ubomi bazo ngeminye iminyaka engama-20. IKoeberg ibivelisa umbane ococekileyo nokhuselekileyo kangangeminyaka engaphezu kwama-40, ihambelana nemigangatho yeshishini, isebenzisa iinkqubo zolawulo ezilinganiswe ngamazwe ngamazwe, kwaye iqesha abasebenzi abafanelekileyo nabagunyazisiweyo.

Ijelifishi yaziwa ngokubangela ukuvalwa kweenkqubo zokupholisa izikhululo zamandla xa zifikelela kuxinano oluphezulu. Iziganeko ezine ezibalulekileyo zokungena kwe-jellyfish zirekhodwe ukususela oko i-KNPS yaqala ukusebenza ngeminyaka yoo-1980, ezona ziganeko zibalaseleyo zingoFebruwari 1997, Juni 1999, Meyi 2005 nangoMatshi 2020. Kuzo zonke iimeko ezine, ukungena okukhulu kwe-jellyfish kwi-inlet basin kwachaphazela kakhulu imisebenzi eqhelekileyo yokufakelwa kwenyukliya.

Amava e-KNPS abonise ukuba ngexesha lokungena kwe-jellyfish kwi-inlet basin, ipesenti ye-jellyfish isuswa kwizikrini ze-rake kunye ne-drum kwaye idluliselwe kwi-wash water waste sump, ngelixa intsalela ye-jellyfish inamathela kwizikrini (ingakumbi isikrini se-drum). Kwiziganeko zangaphambili, isikrini se-drum sagcwala yi-jellyfish nto leyo eyabangela ukuba kusetyenziswe ii-firehoses zoxinzelelo oluphezulu ukucoca isikrini se-drum.

Ukwenzeka, ukusasazwa kunye nobuninzi be-jellyfish kwindawo nakufutshane neendawo zokungenisa amanzi kuhlolwa ukuqinisekisa umngcipheko onokubakho kukhuseleko lokufakwa kwenyukliya olubangelwa kukuvalwa kweendawo zokungenisa amanzi. Oku kusebenza ekuboneleleni ngenkqubo yokulumkisa kwangethuba malunga nokungena kwe-jellyfish. Uluhlu lwezixhobo zokunciphisa izinambuzane lugcinwa kwindawo efanelekileyo, zilungele ukuthunyelwa xa i-jellyfish ingena. Ezi ziquka ukudumba kweoyile, i-skimmer pontoon, amakhethini e-bubble, ipayipi yoxinzelelo oluphezulu, njl. Ukunciphisa ngempumelelo ukungena kwe-jellyfish kwindawo yokungenisa kuxhomekeke ekuthembekeni, ukufumaneka, kunye nokuthembeka kwezixhobo ezisetyenziswa ngexesha lomcimbi onjalo.

6.2 Fukushima Daiichi

Ngomhla we-11 kweyoKwindla ngo-2011, inyikima enobukhulu obuyi-9, eyalandelwa yitsunami eyi-15 m, yonakalise kakhulu ii-reactor zamandla enyukliya kwiziko laseJapan

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iFukushima Daiichi [32]. Emva kwale ngozi, abalawuli bafuna ukuphuculwa okukhulu kwizikhululo zamandla enyukliya. Oku kuquka: ukongeza amandla okugcina imisebenzi ephambili yokhuseleko lwezityalo emva kwentlekele yendalo enkulu; izixhobo ezintsha zokujongana ngcono neziganeko zomonakalo onokubakho kwisiseko se-reactor; ukuqinisa amandla okulungela imeko kaxakeka kwaye kwimeko yovavanyo lwendawo, ukuhlaziya uvavanyo malunga nempembelelo enokubakho evela kwiziganeko zenyikima kunye nezikhukula. Abanini beelayisenisi bamazwe ngamazwe (abaqhubi) baceliwe ukuba bahlaziye kwakhona iziphumo zenyikima kunye nezikhukula ngokusekelwe kwinkqubela phambili kulwazi nokuqonda iingozi zenyikima kunye nezikhukula. Olu vavanyo luphinde lwasebenzisa ulwazi oluhlaziyiweyo kunye neendlela zokwazisa abaqhubi bezityalo ngempembelelo enokubakho kwiindawo zabo. Ngenxa yoko, i-Eskom itshintshe indlela esetyenziselwa uhlalutyo lwengozi yetsunami (THA) kunye nohlalutyo lwengozi yenyikima kwindawo. Ezinye iinguqu kwiimfuno ziquka ukuqwalaselwa kwendibaniselwano ethembekileyo yeziganeko zangaphandle ezibangelwa yindalo kunye nabantu ezinokuchaphazela ukhuseleko lokufakelwa kwenyukliya kwindawo enye okanye kwiindawo ezikufutshane nezikufutshane.

Kwizifundo ezifunyenwe kwingozi yaseFukushima kunye nezinye iingozi ezinxulumene noko ezithathelwe ingqalelo ngexesha lophando lwendawo, oku kulandelayo kubaluleke kakhulu:

- I-LOOP kunye nokungaphumeleli kweenkqubo zokuxhasa indawo kunokuba nemiphumo emibi kakhulu.
- Ukukhukula okuvela elwandle kufunyenwe kuyingozi enkulu ekufuneka ithathelwe ingqalelo kuyilo lofakelo lwenyukliya, oko kukuthi, ithala kufuneka libekwe ngaphezulu kwinqanaba lezikhukula elisekelwe kuyilo, okanye kufuneka kwenziwe udonga olukhuselayo phambi kwethala.
- Ukulahleka kwesinki sobushushu esiphezulu (oko kukuthi, ukulahleka kokupholisa kwamanzi olwandle) kunokukhokelela ekulahlekelweni kwenkqubo yokususa ubushushu obubolileyo.
- Unxibelelwano olungasebenziyo kunye neenethiwekhi zothutho ezijikeleze indawo yofakelo lwenyukliya zinokubeka emngciphekweni ukuphunyezwa kwamanyathelo anxulumene nokhuseleko ngabaqhubi kunye nombutho wocwangciso lwengxakeko ngokwenza iindlela zokubaleka zingadluli kwaye zihlukanise indawo yesityalo kwimeko engxakeko enokwenzeka, kunye nobunzima obulandelayo kunxibelelwano kunye nokubonelela.

I-Eskom iqwalasele iingozi ezivela kwiziganeko eziqatha njengenxalenye yovavanyo lwendawo kwaye ayikhange ichonge naluphi na ubungozi obunokuthintela indawo ye-NPP kwindawo yaseDuynefontyn. Ii-reactor zeGen III ziya kubandakanya ukuphuculwa kokhuseleko olongezelelweyo kunye nokuqina okongezelelweyo kwiingozi ezinkulu

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zangaphandle. I-Eskom izimisele ukufunda kwiziganeko namava afana neFukushima, kunye nokufumana ulwazi olubanzi oluvela kumashishini angengowenyukliya.

7 ISIGQIBELO NGOKWANELEKA KOPHANDO LWESIZA

Indawo yenyukliya yaseThyspunt iphandwe kakhulu ngokubhekiselele kuzo zonke iimpawu zendawo ezinokuba zibalulekile kukhuseleko lofakelo lwenyukliya olucetywayo. Iimpawu zendalo kwindawo yendawo ezinokuchaphazeleka ziziganeko ezinokubakho ze-radiological kwiimeko eziqhelekileyo zokusebenza nakwiimeko zeengozi nazo ziphandwe. Iziganeko zendalo ezinokwenzeka kunye neemeko kunye nemisebenzi ebangelwe ngabantu kummandla wendawo zichongiwe kwaye zavavanywa ngokwentsingiselo yazo yokusebenza ngokukhuselekileyo kofakelo lwenyukliya.

Ulwazi kunye neerekhodi zangaphambi kwembali, zembali, kunye nezirekhodiweyo ngezixhobo, njengoko kufanelekile, zeziganeko kunye nobunzima beziganeko zendalo ezibalulekileyo okanye iimeko kunye nemisebenzi ebangelwe ngabantu ziqokelelwe kummandla kwaye zihlalutywe ngononophelo ukuthembeka, ukuchaneka, kunye nokuphelela.

Iindlela ezifanelekileyo ezilandela iikhowudi kunye nemigangatho yamazwe ngamazwe kunye nokhuseleko zamkelwe ukuze kusekwe iingozi ezinxulumene neziganeko ezinkulu zangaphandle, umzekelo, indlela yanamhlanje, ikomiti ephezulu yohlalutywe lweengozi ze-seismic (SSHAC) inkqubo yeNqanaba lesi-3 yalandelwa ukumisela ingozi ye-seismic kwindawo.

Ubungakanani bommandla apho indlela yokumisela iingozi ezinxulumene neziganeko ezinkulu zangaphandle yayisetyenziswa khona, yayinkulu ngokwaneleyo ukuba iquke zonke iimpawu kunye neendawo ezinokuba negalelo ekumiselweni kweziganeko zendalo nezibangelwa ngabantu eziqwalaselwayo kunye neempawu zesiganeko.

Kuvavanyo lwendawo ukuze kuchongwe impembelelo yayo yemisebe kummandla kwiimeko eziqhelekileyo zokusebenza kunye neemeko zengozi ezinokufuna amanyathelo okuphendula ngokukhawuleza, kufunyenwe uqikelelo olufanelekileyo lokukhululwa kwezinto zemisebe ezilindelekileyo okanye ezinokubakho, kuthathelwa ingqalelo iimpawu ezigubungelayo zezibonelelo ezicetywayo ukuba zakhiwe kwindawo kunye neempawu zayo zokhuseleko.

Iindlela ezithe ngqo nezingathanga ngqo apho izinto zemisebe zinokufikelela kwaye zichaphazele abantu kunye nokusingqongileyo ziphandwe kwaye zivavanywe, kuthathelwa ingqalelo iimpawu ezithile zengingqi kunye nendawo[10].

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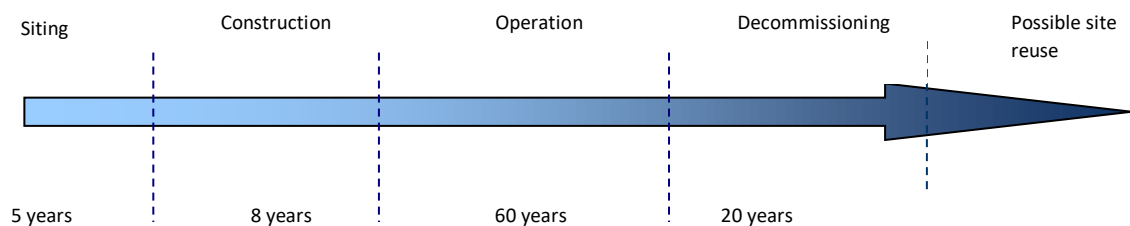
8. IZINTO EZIQWALASELWAYO ZOPHUHLISO LWESIZA

8.1 Amanqanaba oPhuhliso lweNyukliya

Indawo iza kuphuhliswa ngamanqanaba ahlukeneyo ngokuhambelana nePhepha leNNR Position Paper 0009 (PP-0009) (jonga kwiltheyibhile 13) [24].

Itheyibhile 13: Amanqanaba eLayisenisi ze-NNR

Iqonga	Umsebenzi	Imvume yeNyukliya
1(a)	Ukusekwa kwendawo	Imvume
1(b)	Imisebenzi yasekuqaleni kwendawo	I-NISL / NIL ukuya kwindawo
1(c)	Imisebenzi yokwakha yasekuqaleni	I-NIL ukuya kwisiza ngeSicelo soTshintsho lweLayisenisi (LCR)
2(a)	Uyilo (Ukhetho)	Imvume yokuqinisekisa uYilo/uYilo
2(b)	Ukuvelisa (Izinto EzineNkoko Ende)	Imvume yokuvelisa
3(a)	Ulwakhiwo	I-NIL yokwakha i-LCR yoFakelo lweNyukliya
3(b)	Ipetroli eya/eNdaweni	NIL via LCR
3(c)	Ukulayisha kunye nokuQalisa iFuel	NIL via LCR
4	Ukusebenza kweFektri	NIL via LCR
5	Ukucoca kunye nokuVala uLawulo	NIL via LCR



Umfanekiso 39: Amanqanaba oBomi beNdawo eCwangcisiweyo yeThiyori (Ihlengahlengiswe isuka ku [63])

Uninzi lwezikhululo zamandla enyukliya ezikhoyo ekuqaleni zazinelayisenisi iminyaka engama-40. Uyilo olufunwa yi-Eskom lunobomi beminyaka engama-60 olunokwandiswa ukuya kwiminyaka engama-80. Inani kunye noyilo lwee-reactor eziza kwakhiwa zisaza kuqinisekiswa, kodwa ziya kuba zezohlobo lwe-Pressurised Water Reactor.

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9. IMIQATHANGO YOPHUHLISO

Ngokusekelwe kulwazi olufumanekayo malunga neempawu zendawo kunye nokuqwalaselwa koyilo lokuqala, kukhethwe indawo yesithuba esigubungelayo (eboniswe Umfanekiso 16). Le yindawo apho i-reactor kunye nezinye izakhiwo ziya kusekwa khona. Njengoko kungekho mthengisi utyunjiweyo okwangoku, uyilo oluneenkukacha loyilo lwendawo kunye nenani kunye nobukhulu bezakhiwo zezityalo zihlala zingaphambili kwaye zisengqiqweni kwaye ziya kugqitywa kuphela kwinqanaba elilandelayo lokufumana ilayisenisi.

Nangona kunjalo, ulwazi lukhona, iingcamango zinokwenziwa, kunye nemigaqo echazwe malunga nemida ethile yophuhliso lwendawo kunye nemigaqo eya kwazisa uphuhliso lwendawo. Ezi zichazwe kumacandelo alandelayo. Kufuneka kuqatshelwe ukuba ezi zinto zinokutshintsha ngenxa yotshintsho kwidatha yendawo, iimfuno zomthetho okanye utshintsho kwindlela yokusebenza yamazwe ngamazwe.

9.1 Imiqobo yokusingqongileyo

Imvume yokusingqongileyo yanikwa u-Eskom yokuba ukwakhiwa, ukusebenza kunye nokupheliswa kwesikhululo samandla enyukliya (iNuclear-1) kucetywe ukuba kubekwe kwindawo yaseDuynefontyn [2]. U-Eskom uza kufaka isicelo semvume yokusingqongileyo yokwakha, ukusebenza kunye nokupheliswa kwesikhululo samandla enyukliya (iNuclear-2) esicetywayo kwindawo yaseThyspunt. Imida yokusingqongileyo echongiweyo iya kulawulwa ngokuhambelana neSicwangciso soLawulo lokusingqongileyo ngokuhambelana neemfuno zoMthetho woLawulo lokusingqongileyo weSizwe.

9.2 Imiqobo Yomzimba

Le miqathango ilandelayo yomzimba kuya kufuneka iqwalaselwe xa kuchongwa iithara zesikhululo samandla enyukliya.

- Iithara ezixhasa ii-NPP kufuneka zibe kwindawo yokusingqongileyo eneendawo ezisezantsi kakhulu. Oku ke, kuphumela kwinani elincinci lesanti ekufuneka imbiwe kwaye isuswe. Naluphi na utshintsho kule ndawo luya kuba nemiphumo emibi malunga nokumbiwa kweziseko ze-NPP.
- Ubuninzi besanti kunye namatye okuya kufuneka ambiwe, agcinwe, azaliswe kwaye onakeleyo aya kwahluka ngokuxhomekeke kwindawo echanekileyo yethara, ubukhulu kunye nenqanaba elingaphantsi komgangatho woyilo lwesityalo samandla esikhethiweyo.
- Kwiindawo zethara ze-NPP, icandelo eliphezulu lethara liya kugxojwa kwaye kuya kufuneka lilungiswe ngendlela yokuba ithara elinomthwalo ofanelekileyo livezwe. Nje ukuba ithara elinomgangatho livezwe, isiseko sinokufuna ukwakhiwa ngesiseko sesamente yomhlaba phantsi kwesiqithi senyukliya, njengoko kwenzekile kwi-KNPS.
- Izifundo zolwazi lolwandle ezenziweyo ukuza kuthi ga ngoku zibonisa ukuphakama okuphezulu kwesiseko samaza oyilo ngolandelelwano lwe-+14,85 m amsl kwi-

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excendence frequency ye- $1E-07$ y-1. Oku kuphakama kuvela kukudibana kwamaza kunye neemeko zesiphepho, ukuhamba, utshintsho lwemozulu kunye ne-tsunami. Ukuze kubonelelwe ngomda ngokuchasene ne-tsunami yoyilo, ukuphakama kwe-terrace ye-NPPs kufuneka kube ngaphezulu kwe-+15 m amsl. Izifundo ezongezelelweyo zengozi ye-tsunami ziya kwenziwa ngaphambi kokwakhiwa ukuqinisekisa ngakumbi uyilo olufunekayo lwendawo.

- Itafle yamanzi ibonisa i-topography yendawo, inyuka ngokuthe chu ukuya emantla-ntshona. Ii-terrace ze-NPP kufuneka zibekwe ngendlela yokuba kubekho umda omncinci we-2.0 m phakathi kwe-terrace kunye netafile yamanzi. Olu bunzulu ukuya kumanzi angaphantsi komhlaba luya kuba ngaphezu kwe-2.0 m ngaphezu kwenxalenye enkulu yesiza kunye nekona yoMntla Mpuma kuphela efumana ubunzulu obuncinci.
- Njengoko ukuphakama kwe-terrace kuyanda, imfuno yamandla yokupompa amanzi okupholisa kwiiturbines iyakhula. Ke ngoko, kuyacetyiswa ukwenza ngcono kangangoko kunokwenzeka ukuphakama kwe-terrace ngokuchasene nomthwalo wendlu yombane. Kulindeleke ukuba imfuneko yamanzi okupholisa ibe yi-184 m³/s kwi-4 000 MWe, kwaye i-76 m³/s iyadingeka kwi-1 650 MWe kwaye lo mthamo kuya kufuneka upompelwe kwiminyaka engama-60 yobomi be-NPP(s). Oku kuthetha ukulahlekelwa ngumbane kunye nenxalenye yenkcitho yemali engenakufunyanwa.

10 IINGQIQO EZAMKELWAYO ZOPHUHLISO LWESIZA

lingcamango ezixutyushwa kweli candelo zezokuqala nezombono kwaye ziya kuphenjelelwa ziimfuno zelayisenisi kunye nolawulo eziya kufuneka zilandelwe, kunye neendlela zophuhliso lwesiza kunye nezivumelwano eziza kwamkelwa yi-Eskom.

10.1 Indlela zokufikelela

Indawo yaseThyspunt okwangoku ayinazo iindlela zokufikelela ezisemthethweni, kwaye ukwakhiwa kwendlela entsha yokufikelela kuya kufuneka. Xa kufunyenwe iMvume yokuSingqongileyo (EA) kwaye xa kusenziwa isigqibo sokwakha, iindlela zokufikelela ezichongiweyo ziya kwakhiwa ngokuhambelana neemfuno ze-NEMA kunye nemida echongiweyo ngexesha le-EIA.

Iindlela ezine ezilandelayo ezahlulwe ngokwemigangatho ecaleni kwendlela enkulu ye-N2 zinika ukufikelela kwindawo:

- ikhonkco kwindlela ye-R102 eMondplaas;
- indlela yokujika eya eJeffreys Bay;
- ikhonkco kwindlela ye-R330 emantla eHumansdorp;
- ikhonkco kwindlela ye-R62 eDieprivier, njengoko kuboniswe Umfanekiso 41.

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10.2 Ukufikelela kwiSayithi

Njengoko kuboniswe nguMfanekiso 36, indawo inokufikelelwa ukusuka empuma, emantla okanye ukusuka entshona. Iindlela zokufikelela zasentshona nasempuma zezona ndlela zokufikelela ezikhethwayo ezazicetyiswe ngaphambili, nangona kunjalo, ngenxa yempembelelo enkulu yale ndlela yokufikelela kwindalo esingqongileyo kunye nomhlaba ofunekayo kwezi ndlela zokufikelela, kucetyiswa ukuba kuphela indlela yokufikelela empuma ecaleni komgaqo i-R330 yakhiwe njengendlela yokufikelela esemgangathweni egangathiweyo (jonga kuMfanekiso 36). Indlela yokufikelela entshona kufuneka yakhiwe njengendlela yokufikelela enengrable ephantsi eya kusebenza ikakhulu njengendlela yokufikelela engxamisekileyo.

Iindlela Zokungena - Isigaba Sokwakha

Iindlela ezilandelayo zokufikelela ukusuka eHumansdorp ukuya kwindawo yaseThyspunt kunye nezinye iindlela ezinokubakho zivavanyiwe (jonga Umfanekiso 41):

- Oyster Bay Road;
- R330;
- Humansdorp Industrial Bypass.

10.3 Iindlela Zokuphuma Kwindawo Engxamisekileyo

Iindlela ezimbini zokufikelela nazo ziyafuneka ukuze bonke abasebenzi bafuduke ngokukhuselekileyo nangokukhawuleza xa kukho imeko engxamisekileyo. Amalungiselelo angakumbi malunga nokufuduka ngexesha elingxamisekileyo aza kwenziwa kunye noorhulumente basekuhlaleni kunye nemibutho yolawulo lweentlekele xa sele kwenziwe isigqibo esiqinileyo sokwakha isikhululo samandla enyukliya.

10.4 Ukuthuthwa kwemithwalo ongaqhelekanga/enzima

Uninzi lwezinto eziphambili zesikhululo samandla enyukliya zenziwa phesheya kwaye zingeniswa ngolwandle, kwaye uninzi lwezi zinto zikhulu ngokungaqhelekanga xa kuthlekiswa nomthwalo oqhelekileyo wendlela. Ngoko ke, ukuhanjiswa kwindawo ngezithuthi ezithwala umthwalo ongaqhelekanga kuya kufuneka. Uninzi lwezixhobo ezinzima ezivela phesheya ziya kuthuthwa ngenqanawa ukuya kwiZibuko laseGqeberha njengoko lilona zibuko likufutshane neThyspunt elinamandla okuthwala imithwalo enzima. Indlela ecetywayo ilandela iBuffelsfontein Road (M9) kunye neSeaview Road ukusuka kwizibuko laseGqeberha ukuya kwi-N2, emva koko nge-N2 ukuya kwindawo yokutshintshana empuma yeJeffreys Bay, emva koko nge-R102 ukuya eHumansdorp, emva koko nge-Main Street ukuya ePark Street, emva koko nge-R330 ukuya kwi-Eastern Access uze uye kwindawo (jonga Umfanekiso 41).

Amanyathelo alandelayo okunciphisa aya kufuneka kwindlela yomthwalo ongaqhelekanga:

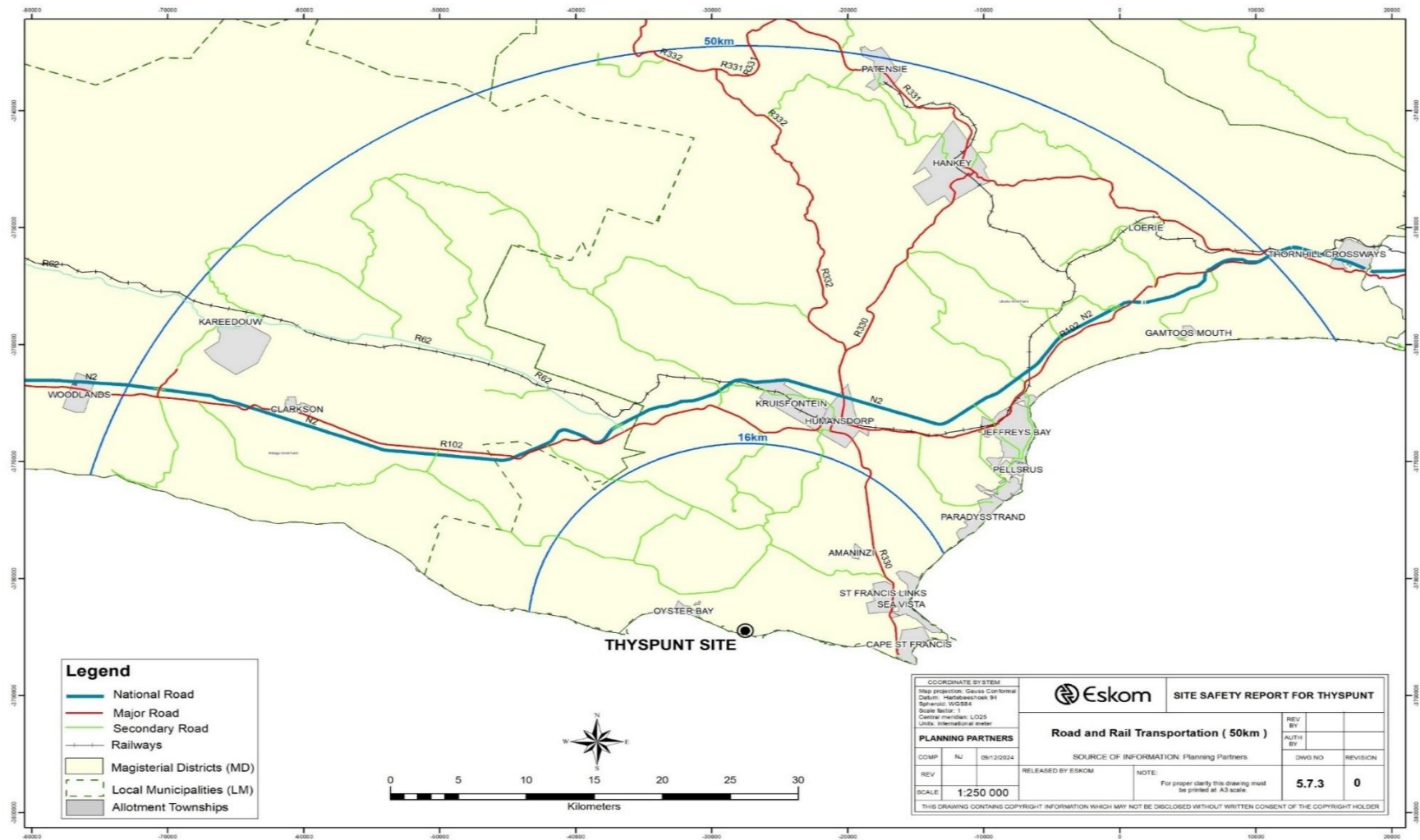
- Indlela yokuwela uloliwe ecaleni kwendlela yokuphuma eGqeberha ifuna ukuphuculwa kwezithuthi zokuthutha.

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- lintambo zombane eziphezulu kufuneka ziphakanyiswe ukuze zilungele ukuphakama okufunekayo.
- libhulorho ezihamba ngaphezulu – Izithuthi zothutho kuya kufuneka zisebenzise iindlela eziya phezulu neziphumayo kwiindawo zokutshintshana ukuze kuthintelwe iibhulorho ezihamba ngaphezulu. Iindlela eziya phezulu kunye neendlela ezijikayo kuya kufuneka zakhiwe apho kufuneka khona.
- Ngaphantsi kweebhulorho – Kuya kufuneka ukufakelwa ipropu kwiibhulorho ezininzi ukuqinisekisa uzinzo ngexesha lokuthuthwa. Kuya kufuneka ukuqinisa nokuxhasa ibhulorho yaseVan Staden. Kuya kufuneka ukuphuculwa kweendlela eziya phezulu kunye neendlela ezijikelezayo.
- Kuyacetyiswa ukuba uhambo olungaqhelekanga lomthwalo lwenzeke ngexesha langokuhlwa, phakathi kwe-21h00 kunye ne-5h00 ukunciphisa impembelelo kwizithuthi.

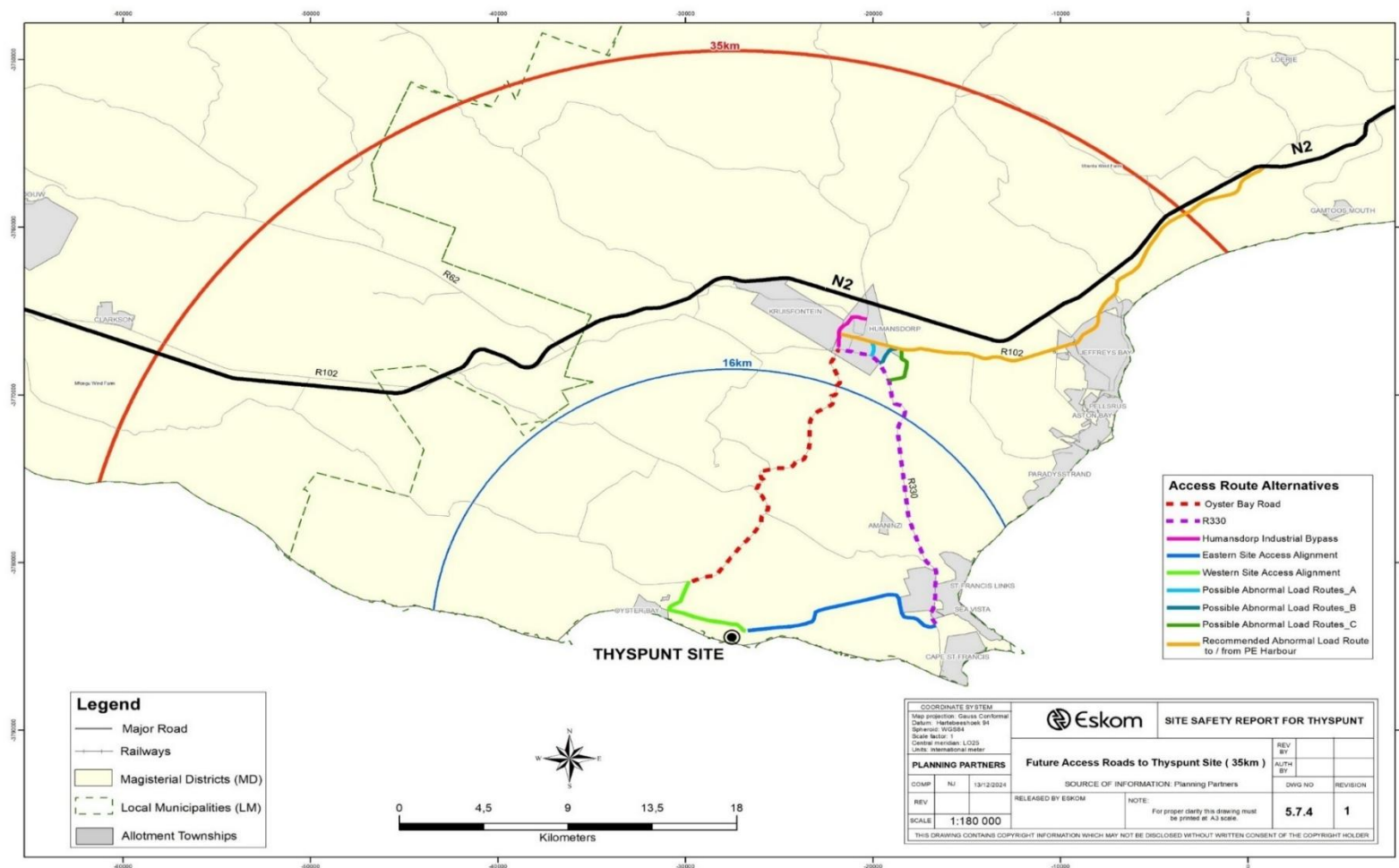
Ngexesha lophando lwangaphambili, kwaphakanyiswa iinkxalabo malunga nokusetyenziswa kweMain Street eHumansdorp kunye nezinye iindlela ezinokwenzeka zokudlula idolophu. Ngenxa yemingeni enokubakho yokuphuculwa kweendlela eziya phezulu kunye nokulungiswa okufunekayo kwiMain Street ukuze kuhlangatyezwane nemithwalo engaqhelekanga, kwacetyiswa indlela eNye (A). Lunxibelelwano oluthe ngqo phakathi kweVoortrekker Road (MR389) kunye neSt. Francis Bay Road MR381 (R330) edibana emantla eKwanomzamo. Le yeyona ndlela imfutshane yendlela edlula empuma, malunga neemitha ezingama-850 ubude kwaye yeyona ifanelekileyo yokwakha (jonga Umfanekiso 41).

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Umfanekiso 40: Uthutho lweNdelela noLoliwe (50 km)

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Umfanekiso 41: lindlela zokufikelela kwixesha elizayo kwisiza saseThyspunt (35 km)

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10.5 Imisebenzi Yomhlaba Emikhulu

Nje ukuba oomatshini bokuhambisa umhlaba bathunyelwe kwindawo leyo, kuya kwenziwa umsebenzi womhlaba omncinci ukuze kubonelelwe ngeeplatifomu zeeOfisi ze-Eskom zexeshana, iZiko leeNdwendwe, iSakhiwo sokuGcina uBuchule, isityalo sokukhupha ityuwa okwethutyana, iitanki zokugcina amanzi acocekileyo, izindlu zangasese eziphathwayo, iitanki zokugcina amanzi amdaka, indawo yokupaka kunye neyadi yekontrahta.

Iindawo ziya kuchongwa

- indawo yokugcina i-mulch
- indawo yokugcina i-helipad
- indawo yokugcina umhlaba ongaphezulu

Emva koko, umsebenzi womhlaba uya kuqhubeka kwi-NPP terrace kunye nee-terrace zezinye izakhiwo. Izinto ezivunjululweyo ziya kusetyenziselwa ukugcwalisa ezinye ii-terrace. Nje ukuba i-NPP terrace ilungiswe yafikelela ekuphakameni kwayo, umsebenzi wokulungiselela ukumba unokuqala. Le misebenzi iya kubandakanya uhlobo oluthile lokukhuculula amanzi olungenakuyichaphazela imigxobhozo. Le misebenzi inokuthatha ixesha elingangeenyanga ezi-8 ngaphambi kokuba kuqalwe ukumba.

Iiyadi zabakhi ziya kwakhiwa ngesanti kwindawo leyo ngenjongo yokufikelela ekusikeni nasekuzaliseni ngokulinganayo kwaye ngoko ke kuncitshiswe kangangoko kunokwenzeka isidingo sokulahla izinto ezingafunekiyo.

Ukuphakama kwee-terrace ze-NPP kufuneka kubekwe kwiindawo eziphakamileyo ezifikelela kumlinganiselo phakathi kokunciphisa izikhukula ezivela elwandle, ukufikelela ubuncinci ubude be-2 m ngaphezu kwetafile yamanzi angaphantsi komhlaba, ukunciphisa ubungakanani bezinto ezingafunekiyo zesanti kunye neemfuno zokumpompa amanzi okupholisa ngexesha lonke lesikhululo samandla.

Indlela yokuguguleka kwezinto ezingeniswayo iya kwakhiwa kuzo zonke ii-terrace eziya kwamkela ithrafikhi yokwakha kwaye zixhase uxinzelelo olusetyenziswayo lwe-150 kPa kwiindawo zokulala. Ii-terraces ziya kuhlolwa ukuqinisekisa ukuba amanzi emvula aya kugeleza kwinkqubo yokukhupha amanzi emvula eza kufakelwa njengenxalenye yomsebenzi womhlaba. Indlela zokufikelela eziphambili ziya kunikezelwa kwii-terraces kodwa ukufikelela kwiiyadi zabakhi ukusuka kwiindlela eziphambili kuya kunikezelwa ngumthengisi. Kufuneka kuqatshelwe ukuba kuya kubakho ukuguguleka komphezulu ngexesha lokwakha kwaye oku kuya kubekwa esweni kwaye kulungiswe apho kuyimfuneko ngumthengisi. Kwakhona okuza kubandakanywa ekwakhiweni kwee-terraces zii-mains zeringi yamanzi asetyenziswa ekuphekeni kunye nomlilo, i-main yeringi yombane enika ukutya phakathi kwezinye izinto, izibane zendawo, amanzi emvula kunye neenethiwekhi zamanzi amdaka.

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Imiphetho yee-terraces iya kuboniswa ngokufanelekileyo ukhuseleko, kubandakanya, ukuba kuyimfuneko, ii-railings okanye ucingo. Ucingo lokhuseleko lwendawo luya kujikeleza indawo yokwakha kwaye luya kwakhiwa xa umsebenzi womhlaba ugqityiwe.

Ilitye elisuswayo kwitonela yokungena kwamanzi okupholisa kunye nokwembiwa kweZiqithi zeNyukliya nezeSiqithi esiQhelekileyo lingasetyenziswa njengezinto zokuzalisa okanye lithuthwe liye kwindawo yokwambatha ukuze lityunyuzwe kwaye lisetyenziswe kwezinye izinto.

10.6 Indandatho Yamanzi Athuthwayo Ephambili

Kuza kusekwa i-water ring main. Ngexesha lokuqala kokwakhiwa, iimfuno zamanzi okusela ziqikelelwa ukuba ziyi-104 l/s. La manzi anokubonelelwa kwimithombo eyahlukeneyo njengoko ukwakhiwa kuqhubeka. Ekuqaleni amanzi okusela aza kunikezelwa kwimigodi ekhoyo kwindawo, kodwa la manzi anokufuna ukucocwa. Amanzi aza kugcinwa kwiitanki zamanzi eziphakamileyo. Njengoko imisebenzi yokulungiselela indawo isanda, ngoko ke imfuno yamanzi iya kwaneliswa linani elongezelelweyo leetanki zokugcina amanzi ezikwiindawo eziphezulu zendawo yokwakha. Amatanki aya kubonelela ngoxinzelelo olwaneleyo lwamanzi okusela, ukuzaliswa kweenkqubo zangasese kunye nezinye iimfuno zoxinzelelo oluphantsi kwizakhiwo zexeshana nezisisigxina njengoko ezi zakhiwo ziphuhliswa. Apho kufuneka khona, iinkqubo zepompo ezinxinzelelweyo zingongezwa ukuze kubekho uxinzelelo olongezelelweyo.

Njengoko imisebenzi emikhulu yomhlaba yee-terraces ezahlukeneyo igqityiwe, kuya kufakelwa i-water ring mains. Amanzi aya kunikezelwa kwisityalo sokususa ityuwa (esiya kuba sigqityiwe ngeli xesha) ukuya kwiindawo zokugcina amanzi eziya kuthi zondle i-ring mains. Iindawo zokutsala amanzi ziya kunikezelwa kwi-ring main njengoko kufuneka kwindawo.

Amanzi aya kugcinwa kwiindawo ezahlukeneyo ezijikeleze indawo yokwakha ukuze kuhlangukanyezwane neemfuno zokulinganisela kunye nokujongana neengxamiseko (umz. ukucima umlilo) okanye ukuvalwa okucwangcisiweyo. Umthamo wokulinganisela uyafuneka ukuze kuhlangukanyezwane nokuphuma kwamanzi aphezulu, ngelixa kufunyanwa ukuhamba kokungena okuphantse kungaguqukiyo. Umthamo wokugcina weeyure ezingama-48 zemfuno yemihla ngemihla yonyaka uyacetyiswa, nangona kunokubakho iimeko apho iiyure ezingama-24 ziya kwanela.

Umthamo oqhelekileyo wokugcina ophezulu, ngokusekelwe kwixesha eliqhelekileyo elibandakanyeka ekucinyweni kombane, uya kusekelwa kwiiyure ezi-2 ukuya kwezi-4 zemfuno ekhawulezileyo. Umthamo oqhelekileyo wepompo yomsebenzi kufuneka ulingane nesixa seemfuno ekhawulezileyo.

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10.7 Inkqubo Yamanzi Emvula

Njengoko kuphawuliwe phantsi kwemisebenzi emikhulu yomhlaba, iinkqubo zamanzi emvula zamathala ziya kubandakanywa ekwakhiweni kwamathala.

Amanzi emvula aya kuqokelelwa ngenkqubo yeendlela, imibhobho yamanzi emvula, kunye nemijelo evulekileyo. Imijelo evulekileyo yeyona ndlela ikhethwayo ngokuyintloko ngokwembono yeendleko zokwakha kunye nokugcinwa.

Ngaphambi kokuba ikhutshelwe kwindalo esingqongileyo, amanzi emvula aya kudlula kumadama okusingqongileyo / izakhiwo zokuqokelelwa kwenkunkuma ezenzelwe ukuqokelela zonke iintlobo zezinto eziqinileyo ezithunyelwa emanzini kunye nemigibe yeoyile/igrisi ukuba ungcoliseko lunokwenzeka. Emva koko, aya kukhutshelwa kwizityalo ezivulekileyo ezivela kumathala ahlukeneyo kunye nezakhiwo zokusasaza amandla ezisetyenziselwa ukuthintela ukukhukuliseka kwiindawo zokuphuma.

Amanzi emvula aya kuqwalaselwa ukuba akhutshelwe kwisinki sokungenisa amanzi abandayo xa esebenza.

Uphando lubonisa ukuba ukuhamba kwexesha elide okuqhele ukwenzeka kumadama okugcina amanzi kuchaphazela kakubi imilambo / imilambo efumana amanzi, ngakumbi xa imilambo kunye nemilambo iphantsi kokukhukuliseka kwamanzi ixesha elide. Amanzi amileyo akwasebenza njengendawo yokuhlala yeengcongconi ezinxulumene nezifo. Ke ngoko, ukusetyenziswa kwamachibi okugcina amanzi kuya kufuna ingqalelo ekhethekileyo ukuba kucingelwa ukuba kusetyenziswe kwindawo leyo.

10.8 Inkqubo yoGutyulo lwelindle

Ngexesha lokuqala kokwakhiwa, kuza kusetyenziswa izindlu zangasese ezinekhemikhali ezibonelelwa kwaye zilungiswe ngumboneleli wenkonzo ozimeleyo. Amatanki okugcina amanzi aza kunikezelwa njengeendawo eziphambili zokuqokelelwa kwamanzi amdaka. Ukusuka kula matanki amanzi amdaka aza kuhanjiswa aye kumasipala wengingqi ukuze acocwe.

Nje ukuba isityalo sokucocwa kwamanzi amdaka sexeshana (STP) siqaliswe kwaye kufakwe inethiwekhi yemibhobho yamanzi amdaka, unyango lwenkunkuma luya kwenziwa kwindawo leyo. I-STP yexeshana inokufuna ukufuduselwa kwindawo yayo yokugqibela emva kokuba ulwakhiwo lwethala lugqityiwe. I-STP iya kuba yeyodwa yokubonelela ngotshintsho kwisantya sokuhamba kwamanzi kulo lonke ixesha le-NPP. I-STP ayizukudibana nesiqithi senyukliya kwaye yonke inkunkuma eveliswayo enokuthi ingcoliswe iya kuphathwa ngokwahlukeneyo ngaphakathi kwesiqithi senyukliya.

Kunokubakho iindawo ezingaphezu kwesinye zokuqokelelwa kwenkqubo yamanzi amdaka, kodwa ezi ziya kunqunyelwa kangangoko kunokwenzeka ukunciphisa inani lezikhululo zokumpompa ezakhiweyo. Ezi pumps ziya kupompa amanzi amdaka aye kwi-STP.

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10.9 Indandatho yoMbane ephambili

Inkqubo yokubonelela ngolwakhiwo iya kuba nenethiwekhi yekhebula ye-11 kV enikwa kwisitishi esincinci/isitishi sokutshintsha. Isitishi esincinci siya kuqala sinikwe umgca we-22 kV ovela kwinethiwekhi yokutshintsha umbane ekhoyo kuloo ndawo. Unikezelo luya kongezelelwa ngomgca we-132 kV ngexesha lokwakhiwa. Unikezelo lwe-132 kV luya kwehliswa luye kwi-11 kV.

Inethiwekhi yekhebula ye-11 kV iya kusetyenziselwa ukubonelela ngezikhululo ezincinci ezikwiindawo ezahlukeneyo zokubonelela kwindawo. I-11 kV iya kwehliswa ukuze inike umthengisi i-400 V enezigaba ezi-3. I-400 V yi-voltage esemgangathweni yaseMzantsi Afrika yezixhobo zoshishino zezigaba ezi-3. Inethiwekhi yekhebula ye-11 kV inokubonelela nge-11 kV ngqo kumthengisi ukuba kuyimfuneko.

Indawo yesityalo, umzekelo izikhululo ezitshintsha umbane, izikhululo ezincinci kuya kugqitywa ngayo xa kujongwa ezi zinto zilandelayo:

- Ukuhamba kwezithuthi nabahamba ngeenyawo.
- Impembelelo yokusingqongileyo.
- Ukugeleza kwamanzi.
- Ungcoliseko.
- Ukufikeleleka ukuze kube lula ukusebenza nokugcinwa, kunye
- Indawo yezinye iinkonzo ezingaphantsi komhlaba, umzekelo iintambo zonxibelelwano, amanzi njl.njl.

10.10 Ukukhanya Kwangaphandle

Ngexesha langaphambi kokwakhiwa, iindawo eziphambili ezixhalabisayo ngokukhanyisa yi-Eastern Access Road, i-Contractor Facility, i-Electrical Substation Yard kunye ne-Eskom Site Office Facilities.

Uninzi lwezibane zangaphandle nokuba zifakwe kwiipali okanye zifakwe kumphezulu kwizakhiwo kufuneka zibe nolawulo lokukhanyisa nge-photocell, oko kuthetha ukuba izibane zihlala zikhanya ukususela ngokuhlwa kude kube sekuseni ngeenjongo zokhuseleko.

Iindlela ezincinci kunye nezakhiwo ezijikeleze indawo kufuneka zikhanyiswe ngokwaneleyo ukuvumela iimoto kunye nabahambi ngeenyawo ukuba bajikeleze indawo. Amanqanaba okukhanyisa akufuneki abe ngaphezulu. Ukusetyenziswa kakhulu kwezibane ezikhanyayo kunye nezibane ezifakwe kumphezulu ezinee-engile ezibukhali kunye nokusasazwa kokukhanya okuphezulu akufuneki kukhuthazwe.

Ukukhanya okuphezulu kucwangciswe okwethutyana kwiindawo ezahlukeneyo kwindawo.

10.11 Unxibelelwano

Inkqubo, izakhiwo kunye neenqaba zokulungiselela unxibelelwano lwendawo ziya kwakhiwa kwaye ziqaliswe njengoko umsebenzi wokwakha umhlaba ugqityiwe kwiithara.

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11 IZINTO ZETYALA LOKHUSELEKO

Uphando lwendawo yaseThyspunt lwenziwe ngononophelo lweNyukliya ngaphakathi kwendawo yolawulo olucwangcisiweyo, kwaqokelelwa ulwazi olupheleleyo malunga neempawu zendawo, kwachazwa iiparameter zoyilo oluthile lwendawo kwaye kwaboniswa ukufaneleka kwendawo ngokuhambelana neemfuno zika-Eskom ngelixa kuzalisekiswa neemfuno zokhuseleko zabalawuli benyukliya besizwe, oko kukuthi, uMthetho weSizwe woLawulo lweNyukliya (i-NNR) kunye neMimiselo yoLawulo lweLayisenisi zeSayithi zoFakelo olutsha lweNyukliya. Uphando lwendawo yaseThyspunt lwenziwe ngononophelo lweNyukliya ngaphakathi kwendawo yolawulo olucwangcisiweyo, kwaqokelelwa ulwazi olupheleleyo malunga neempawu zendawo, kwachazwa iiparameter zoyilo oluthile lwendawo kwaye kwaboniswa ukufaneleka kwendawo ngokuhambelana neemfuno zika-Eskom ngelixa kuzalisekiswa neemfuno zokhuseleko zabalawuli benyukliya besizwe, oko kukuthi, uMthetho weSizwe woLawulo lweNyukliya (i-NNR) kunye neMimiselo yoLawulo lweLayisenisi zeSayithi zoFakelo olutsha lweNyukliya.

11.1. Uhlalutyo Lokhuseleko

Uvavanyo kunye nokuhlolwa kweziganeko zangaphandle kwindawo yaseThyspunt akuthinteli indawo ekusekweni kofakelo lwenyukliya. Iziganeko zangaphandle ezivavanyiweyo bezi:

- zihlolwe ukuba zingaqwalaselwa njengesiseko soyilo;
- zihlolwe ngokwemiqathango yokuba imeko iqinisekiswa xa uyilo oluthile lukhethiwe; okanye
- ziya kuhlulwa ngokusebenzisa:
 - o iimpawu zoyilo lofakelo(o) lwenyukliya olucetywayo; okanye
 - o amanyathelo okukhusela indawo.

Uvavanyo lwedosi ye-radiological olwenziweyo lubonisa ukuba idosi yonke yonyaka yomntu omeleyo iqikelelwa ngokolondolozo ukuba yi-0.2 milisievert ngo nyaka. Ngoko ke kunokugqitywa kwelokuba ufakelo(o) olutsha lwenyukliya kwindawo enomthamo omkhulu wokuvelisa we-33 000 MWth luya kuthobela umda wedosi kawonkewonke olawulwa yi-NNR kunye namaxabiso othintelo lwedosi yendawo ye-1 milisievert ngo nyaka kunye ne-0.25 milisievert ngo nyaka ngokwahlukeneyo.

Uvavanyo lomngcipheko we-radiological lwenziwe kwi-biota engeyoyabantu xa kucingelwa ukuba kuphuma ukukhutshwa ngaxeshanye kwi-NNPS kwaye i-KNPS yenziwe kusetyenziswa i-ERICA Tool. I-ERICA Tool yisofthiwe eyenzelwe ukubonisa nokuvavanya impembelelo ye-radiation kwi-ecosystem yasekuhlaleni (izityalo nezilwanyana). Uvavanyo lubonisa ukuba izityalo okanye izilwanyana ezivavanyiweyo kuloo ndawo aziyi konakaliswa yi-radiation. Zonke iintlobo ezivavanyiweyo ziwela ngaphantsi komda wovavanyo we-10 $\mu\text{Gy/h}$ nto leyo ethetha ukuba akukho mpembelelo ibalulekileyo elindelekileyo kwizilwanyana okanye kwizityalo.

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Uphononongo lweNqanaba lesi-3 loVavanyo loKhuseleko oluNgxamisekileyo olwenziwe kwindawo lugqibe kwelokuba umngcipheko wonyaka olindelekileyo wesikhululo ngenxa yeengozi ze-reactor kunye neengozi ze-reactor ezibangelwa yingozi yangaphandle yokufakelwa kwe-reactor ye-EPR yeeyunithi ezi-6 okanye ukufakwa kwe-reactor ye-AP1000 yeeyunithi ezi-8 kubemi abakwi-radius ye-50 km ejikeleze indawo uthathwa njengongaphakathi kwimida yomngcipheko we-NNR enemida efanelekileyo.

11.2 Inkqubo Yolawulo

Inkqubo ebanzi nedibeneyo yokulawula ukhuseleko kunye nomgangatho yasungulwa ukulawula ukusebenza kakuhle kokwenziwa kophando lwendawo kunye novavanyo kunye nemisebenzi yobunjineli eyenziwa kwizigaba ezahlukeneyo zovavanyo lwendawo.

Inkqubo yolawulo igubungela ulungiselelo, ucwangciso, ulawulo lomsebenzi, iziqinisekiso zabasebenzi kunye noqeqesho, ukuqinisekiswa, kunye namaxwebhu, ngoko ke kuqinisekisa ukuba umgangatho ofunekayo womsebenzi ufezekisiwe. Iirekhodi zomsebenzi ezenziwa kwimisebenzi yovavanyo lwendawo kumjikelo wobomi bonke bokufakelwa kwenyukliya ziyagcinwa.

Inkqubo yokuqinisekisa umgangatho yaphunyezwa kuyo yonke imisebenzi enokuchaphazela ukhuseleko okanye ukufunyanwa kweeparamitha zesiseko soyilo lwendawo. Inkqubo yokuqinisekisa umgangatho yahlelwa ngokwembaluleka yokhuseleko lwemisebenzi nganye yokubeka eqwalaselwayo.

Iqela lokubeka i-Eskom lalinoxanduva olupheleleyo lokuphumeza imisebenzi yokubeka isayithi. Iqela lokubeka isayithi liqulathe inani lezazinzulu/iingcali ezazifanelekile kwaye zinamava kwizifundo ezifanelekileyo ezifunekayo zokubeka isayithi. Eli qela lichaze umsebenzi omele wenziwe kwaye lijongamele uphando kunye nokuhlolwa kokwamkelwa kweengxelo zokubeka isayithi ezibhala iziphumo zophando lokubeka isayithi.

Ngenxa yoluhlu olubanzi lwezifundo kunye nokubonelela ngoluhlu lobuchwephesha obufunekayo ekuchazeni indawo kunye nophuhliso lwetyala lokhuseleko, iqela lokubeka indawo lonyuswe ngokuthenga iinkonzo zabacebisi abaziingcali. Izivumelwano zenziwe kunye nabacebisi abaninzi baseMzantsi Afrika abaziwayo. Zonke izixhobo ezivunyelweneyo zavunywa ngababoneleli beenkonzo zenyukliya kwaye baqeshwa ngomsebenzi othile ngokusekelwe kwiziqinisekiso zabo kunye namava abo. Abacebisi babeneziqinisekiso ngokuhambelana neemfuno zolawulo lomgangatho nokhuseleko lwe-Eskom kunye nezo ze-RD-0034 ye-NNR (limfuno zoLawulo loMgangatho noKhuseleko loFakelo lweNyukliya) [22], malunga nenqanaba lokhuseleko lwenyukliya lwenkonzo/imveliso abayinikileyo. Abacebisi basebenzise iinkqubo zolawulo ezihambelana ne-RD-0034 [20] kunye ne-ISO 9001:2008 [11]. Iinkqubo zolawulo zibonelela ngesakhelo sokukhuthaza, ukubeka esweni, ukugcinwa, kunye nokuphucula inkcubeko eqinileyo yokhuseleko, ukuqinisekisa ukuqonda okufanayo kweempawu eziphambili zenkcubeko yokhuseleko. Ukunamathela kwiimfuno zomthetho zasekuhlaleni kunye nokuthobela imigaqo ethile yesizwe kunye neemfuno zomthetho ezivela kwi-NNR kwaqinisekiswa.

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Ngokukodwa, ukuphunyezwa kweemfuno ze-RD-0034 kunye neemfuno ze-RG-0016 [30] (limfuneko zokungeniswa kweMvume ezibandakanya iSoftware yeKhompyutha kunye neeModeli zoVavanyo lweeBalo zoKhuseleko) ngabenzi bemisebenzi efanelekileyo zirekhodwe kwaye uphononongo lokwamkelwa lwenziwa yi-Eskom.

11.3 Inkqubo Yenkxaso Yomsebenzi

Ngenjongo yesicelo se-NISL, inkqubo yenkxaso yokusebenza eza kusetyenziswa ichazwe ngokufutshane nje. Inkqubo yenkxaso yokusebenza iza kuchazwa ngokweenkcukacha ezininzi kwi-PID eza kuphuhlisa njengenxalenye yesicelo se-NIL.

Inkqubo yenkxaso yokusebenza (i-OSP) luludwe lweenkqubo zokhuseleko, izicwangciso, kunye neenkqubo ezisetyenziselwa ukulawula ukusebenza kwesityalo ukuze kuhlontshwe iiparameter zokhuseleko lwesityalo, kwaye iingcamango ezenziwe kuhlalutyo lokhuseleko zihlala zisebenza. Amaxwebhu kunye neenkqubo ze-OSP ziya kuphuhlisa ngokuhambelana neemfuno zetyala lokhuseleko kwinqanaba ngalinye lelayisenisi yesicelo se-NISL kwaye ziya kuqwalasela umthengisi okhethiweyo kunye nohlobo lwesityalo samandla enyukliya, xa sele simiselwe. I-OSP iya kujongana nale mimandla ilandelayo: OSP requirements description document;

- Inkqubo yophuhliso lwe-OSP;
- linkcukacha zobugcisa bokusebenza (i-OTS);
- Inkqubo yoLondolozo;
- Uvavanyo lwangaphakathi (IST);
- Inkqubo yokuhlolwa kwangaphakathi (ISI);
- Inkqubo yolawulo loqwalaselo;
- Inkqubo yophuhliso locwangciso lwengxakeko;
- Inkqubo yokujonga okusingqongileyo;
- Inkqubo yokujonga imozulu;
- Ukugcinwa nokuhlaziywa kwengxelo yokhuseleko lwendawo;
- Inkqubo yokukhusela imitha;
- Inkqubo yokulahla inkunkuma yenyukliya esetyenzisiweyo kunye ne-radiological;
- Amava okusebenza kwezityalo kunye neenkqubo yokulungisa;
- Isicwangciso sokhuseleko lomzimba;
- linkqubo zokusebenza (eziqhelekileyo, iziganeko, iingozi);
- Iindlela zoyilo lokunciphisa iingozi ezinzima.

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Amanye amaxwebhu anxulumene nezifundo ezidweliswe apha ngasentla anokugqitywa kuphela xa iteknoloji okanye umthengisi ekhethiwe kuba oku kunokuchaphazela iinkqubo, izakhiwo, kunye namacandelo esityalo kunye nokusebenza kwazo. Abasebenzi abafunekayo ukuqokelela nokuphonononga la maxwebhu baya kuqeqeshwa ngokwaneleyo kwaye bagunyaziswe kwicandelo labo lobuchwephesha ngokuhambelana neenkqubo ezifanelekileyo zoqeqesho lwe-Eskom.

11.4 Ukuthobela Imigangatho Yokhuseleko

11.4.1 Isakhelo Solawulo

Isiseko esisemthethweni sokufumana i-NISL sinikwe kuMthetho we-NNR (uMthetho onguNombolo 47 ka-1999), ngokukodwa amacandelo:

- 2(1) Ngokuxhomekeke kumhlathi ongezantsi (2), lo Mthetho usebenza ku, (a) indawo, uyilo, ulwakhiwo, ukusebenza, ukucoca, ukuphelisa kunye nokuvala naluphi na ulwakhiwo lwenyukliya.
- 5(b) inika i-NNR igunya, phakathi kwezinye izinto, lokulawula ulawulo oluhambelana nokhuseleko kwindawo, ukuyila, ukwakha, ukusebenza, ukuvelisa iindawo zenxalenye, ukucoca, ukuphelisa, kunye nokuvala ulwakhiwo lwenyukliya ngokukhupha imvume yenyukliya.
- 20(1) ithi: “Akukho mntu uvumelekileyo ukuba abeke, akhe, asebenzise, asuse ukungcola, okanye asuse ulwakhiwo lwenyukliya, ngaphandle kwegunya lelayisenisi yokufaka inyukliya”. Ngokwemigaqo yale candelo, indawo, ulwakhiwo, ukusebenza, ukucoca, okanye ukuphelisa ulwakhiwo lwenyukliya kufuneka kugunyaziswe ngelayisenisi yenyukliya enikwe yi-NNR.
- Isigaba 21(1) sifuna ukuba nabani na ofuna ukwakha, ukwakha, ukusebenzisa, ukucoca, okanye ukuphelisa ukufakwa kwenyukliya angafaka isicelo kwigosa eliyintloko le-NNR selayisenisi yokufaka inyukliya kwaye kufuneka anikezele ngolwazi olufunekayo kwibhodi yabalawuli be-NNR.
- Isigaba 23(2) sithi iGosa eliyiNtloko linokuthi, ngokuxhomekeke kumhlathi (3), limisele (kwaye lilungise) imiqathango yemvume efunekayo ukuqinisekisa ukukhuselwa kwabantu, impahla, kunye nokusingqongileyo kumonakalo wenyukliya, okanye ukubonelela ngokulungiswa kwendawo.

U姆thetho wo姆thetho weSizwe, u姆thetho No. 26 ka-2024, opapashiwe kwiRiphabliki yo姆zantsi Afrika iGazethi kaRhulumente, No. 51804, 20 Disemba 2024 [38]

Ezinye iimfuno zomthetho ezisebenzayo ekubekweni kwezakhiwo zenyukliya zezi:

- R.388 (Umgaqo kwiMigangatho yoKhuseleko kunye neMisebenzi yoLawulo) [4]
- R.927 (Umgaqo kwiLayisenisi yeZiza zoFakelo olutsha lweNyukliya) [1]

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- Umgaqo GN1219 (Imigaqo kwiFomati yeSicelo seLayisenisi yoFakelo lweNyukliya okanye iSatifikethi soBhaliso okanye iSatifikethi soKhululwa) [5]
- RD-0024 (limfuneko zoVavanyo loMngcipheko kunye nokuThotyelwa kweMigqaliselo yoKhuseleko oluPhambili loFakelo lweNyukliya) [21]
- RD-0034 (limfuneko zoLawulo loMgangatho noKhuseleko loFakelo lweNyukliya) [22]
- RG-0011 (Isikhokelo seThutyana soKwakhiwa kweNyukliya Izibonelelo) [29]
- RG-0016 (Isikhokelo soQinisekiso kunye noQinisekiso lweModeli zoVavanyo kunye nokubala ezisetyenziswa kuHlalutyo loKhuseleko kunye noYilo) [30]
- PP-0009 (limvume zoFakelo lweNyukliya). [24]
- PP-0014 (Ukuqwalaselwa kwezehlo zangaphandle okanye ukufakwa kweNyukliya) [26]
- PP-0015 (Isiseko soBugcisa beSicwangciso soNgxamiseko soFakelo olutsha lweNyukliya) [25]

Eminye imithetho ethathelwe ingqalelo ibandakanya:

- UMthetho wezeMpilo noKhuseleko eMsebenzini (OHSA), ka-1993 (UMthetho Nombolo 85 ka-1993) [33]
- limfuno zokusingqongileyo ngokwemigaqo yoMthetho woLawulo lweNdalo yeSizwe (NEMA), ka-1980 (UMthetho Nombolo 47 ka-1998) [34].

11.4.2 Imigangatho Yamazwe Ngamazwe, Amava, Kunye Nendlela Ebalaseleyo Yokuziphatha

Iziphumo ezivela kuphando lwendawo zivavanywe ngokuchasene nokuthotyelwa kweemfuno zomthetho wenyukliya wesizwe, ngakumbi:

- R.388, efunekayo: [4]
 - o Imida yedosi esebenzayo kwilungu eliqhelekileyo leqela elibalulekileyo kuluntu oluchaphazelekileyo iya kuba ngaphantsi kakhulu kwemfuneko yommiselo wedosi olawulayo we-0.25 millisievert ngonyaka kwaye umda wedosi esebenzayo yonyaka kumalungu oluntu kuzo zonke izenzo ezigunyazisiweyo awuyi kudlula umda we-1 mSv.
 - o Inkcubeko yokhuseleko yakhuthazwa kwaye yagcinwa ukukhuthaza isimo sengqondo sokubuza nokufunda malunga nokhuseleko lwenyukliya.
 - o Kwasekwa iinkqubo zolawulo (iinkqubo zolawulo lomgangatho).
- R.927, efuna: [1]

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o Ufakelo(o) olutsha lwenyukliya, lubonisa ngoyilo, ulwakhiwo kunye nokusebenza kwalo, amathuba aphantsi amkelekileyo eziganeko ezicingelwayo ezinokubangela ukukhutshwa kobuninzi bezinto ze-radiological.

o Indawo yendawo kunye neempawu zokhuseleko ezicwangcisiweyo zazo zonke izinto zenyukliya, ezibandakanyiweyo njengeendlela zokhuseleko ngokuchasene nemiphumo eyingozi yeziganeko ezicingelwayo, ziqinisekisa umngcipheko ophantsi owamkelekileyo wokuvezwa luluntu.

o Indawo injalo kangangokuba idosi ye-radiological kunye nomngcipheko ovela ekusebenzeni okuqhelekileyo kunye neziganeko ezicingelwayo ezinxulumene nazo zonke izinto zenyukliya ezikufutshane ziya kuba phantsi ngokwamkelekileyo.

o Iziganeko zendalo kunye neengozi ezinokubakho ezenziwe ngabantu zibalwa ngokufanelekileyo.

o Izicwangciso zongxamiseko ezifanelekileyo kunye namanyathelo okhuseleko lwenyukliya zinokuphuhliswa.

o Impembelelo ye-radiological eqokelelweyo kuzo zonke izinto ezifakelwayo kunye nezenzo zenyukliya, ezikufutshane, iyalinganiswa.

- RG-0011, efuna:[29]

o Kuqinisekisiwe ukuba imiqathango yokhuseleko lwenyukliya (ephathelele umthamo kunye nomngcipheko), enxulumene nokhuseleko loluntu, inokulandelwa xa kujongwa iimpawu zendawo kunye neendawo ezikuyo, kunye nolwazi lokuqala malunga noyilo kunye nokusebenza kwezibonelelo.

o Iimpawu zendawo azithinteli uyilo lwetekhnoloji ezicetywayo zokwakha kwindawo.

o Kunokwenzeka ukuphuhlisa nokusebenzisa izicwangciso zongxamiseko kunye nokhuseleko, xa kujongwa iimpawu zendawo kunye neendawo ezikuyo.

o Kuya kuba nokwenzeka ukwenza amalungiselelo okulawula uphuhliso olukufutshane.

- RD-0024, efuna ukuba [21]:

o Umngcipheko kuluntu ngenxa yeemeko zengozi uchongwe.

o Umthamo kuluntu ngenxa yemisebenzi eqhelekileyo uchongwe. • I-RD-0034 ifuna ukuba i-Eskom kunye nabacebisi bayo basebenzise iinkqubo zolawulo ezidibeneyo zokulawula uphando lwesiza kunye nengxelo yeziphumo ngaloo ndlela kuqinisekiswa ukuba imveliso ekhuselweyo iyaziswa.

Add RD-0034 [22], efuna ukuba efuna ukuba i-Eskom kunye nabacebisi bayo baphumeze iinkqubo zolawulo ezidibeneyo (integrated management systems)

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ekulawuleni uphando lokukhethwa kwesiza (siting investigations) nasekuniken ingxelo ngeziphumo ezifunyenweyo, ngaloo ndlela kuqinisekiswa ukuba kuhanjiswa imveliso enokuxhaswa, ikhuseleke ngokobungqina, kwaye ithetheleleke ngokobugcisa.

- I-RG-0016 [30] ifuna ukuba zonke iimodeli zokubala kunye/okanye iimodeli zovavanyo ezisetyenzisiweyo kuhlalutyo lokhuseleko lwesiza ziqinisekiswa kwaye ziqinisekiswa, ngaloo ndlela kuqinisekiswa ukuqina kwazo zonke iimodeli kunye nokuchaneka kweziphumo.

11.4.3 MIGANGATHO YAMAZWE NGAMAZWE, AMAVA, KUNYE NEENDLELA EZIZEZONA ZILUNGILEYO ZOKUSEBENZA

Izifundo zophando lwendawo yaseThyspunt zathathela ingqalelo imigangatho efanelekileyo yokhuseleko yamazwe ngamazwe kunye neengcebiso ezikhoyo, kwakunye nezifundo ezifundiweyo neendlela zokusebenza ezizezona zilungileyo ezivela kumazwe anamava kwicandelo lovavanyo lwendawo nokuphuhlisa kofakelo olutsha lwamandla enyukliya. Eyona mithombo iphambili ethathelwe ingqalelo idweliswe kwiSihlomelo A.

12. ISICWANGCISO SOKULUNGISELELA NOKUPHENDULA NGEXESHA LENYUKLIYATHI NE-RADIOLOJI

12.1 Ucwangciso olucetywayo lweNgxakeko

Yimfuneko yelayisenisi ukuba umnini welayisenisi yesikhungo senyukliya esisebenzayo okanye umfaki-sicelo wokwakha isikhungo esitsha senyukliya abonise ukuba isicwangciso sokulungela imeko engxamisekileyo kunye nokuphendula kunokwenzeka. Iinjongo eziphambili zesisicwangciso semeko engxamisekileyo senyukliya kunye ne-radiological zezi:

- 1) *Ukuthintela* iziphumo zempilo eziqinisekileyo (ukufa kunye nokwenzakala) ngokuthi:
 - a) uthathe inyathelo ngaphambi okanye emva nje kokukhululwa okanye ukuvezwa okukhulu (umonakalo ophambili) kwingozi ye-reactor;
 - b) ugcine iidosi zikawonke-wonke kunye nezabasebenzi bexesha likaxakeka zingaphantsi komda weziphumo zempilo eziqinisekileyo.
- 2) Ukunciphisa umngcipheko weziphumo ezingalindelekanga kwimpilo (ngokuyintloko umhlaza kunye neziphumo ezibi zofuzo) ngokuthi:
 - a) usebenzise isenzo sokukhusela ngokuhambelana nesikhokelo se-IAEA;
 - b) ugcine idosi yabasebenzi bexesha likaxakeka ingaphantsi komda wedosi yabasebenzi emiselweyo.

Ukuthintela iziphumo zempilo eziqinisekileyo kunokufezekiswa ngokuthatha amanyathelo okukhusela emva nje okanye ngaphambi kokukhululwa. Ezi zenzo kufuneka zisekelwe kwimeko yesityalo kwaye zihlaziye ngokusekelwe kumlinganiselo wokusingqongileyo. Ngokufanayo, ukuthintela umngcipheko weziphumo zempilo ezingaguqukiyo kuncitshiswa

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ngokuthatha amanyathelo ngokusekelwe kumazinga edosi engqongileyo kunye nohlalutyo lweesampuli zokusingqongileyo.

Ukwakhiwa kwesikhululo samandla enyukliya esitsha (i-NPS), uvavanyo lokwenzeka kwesicwangciso sengxakeko (i-EP) lwenziwe njengenxalenye yovavanyo lwempembelelo yokusingqongileyo (i-EIA) yeprojekthi kwaye njengenxalenye yohlalutyo lokhuseleko lwendawo oluye lwafikelela kwingxelo yempembelelo yokusingqongileyo (i-EIR) kunye nengxelo yokhuseleko lwendawo (i-SSR) ngokwahlukeneyo. Uvavanyo lokwenzeka kwe-EP yinxalenye yovavanyo olupheleleyo lokhuseleko olukhula ngokweenkcukacha ngexesha lamanqanaba amaninzi elayisenisi yenyukliya. Lufikelela kwisicwangciso sokugqibela sengxakeko esisekelwe kuyilo oluneenkcukacha kunye nokwakhiwa okugqityiweyo kwe-NPS ngaphambi kokusebenza kokuqala okuya kungeniswa kwi-NNR ukuze kwamkelwe.

I-EP ibandakanya amalungiselelo asekelwe kwiikhrayitheriya ezibekwe kwangaphambili ukumisela ukuba kuza kuthatyathwa nini amanyathelo okukhusela ahlukeneyo kunye nokuba yeyiphi izakhono ezifunekayo ukukhusela nokwazisa abasebenzi kwindawo yesiganeko kunye noluntu. La malungiselelo asekelwe kwiindawo zokucwangcisa iimeko ezingxamisekileyo (ii-EPZ) ezimele iindawo apho ucwangciso lwezenzo ezithile zokukhusela lusekelwe kwiingozi zempilo eziqikelelweyo ezibangelwa zezo ngozi, phantsi kweemeko ezinzima, ezinokukhupha i-radioactivity kwindalo esingqongileyo. Amanyathelo okukhusela aquka amanyathelo okunciphisa ukuvezwa koluntu kungcoliseko lwe-radioactive ngokuvezwa kwimitha yangaphandle, ukuphefumla i-radioactivity emoyeni, kunye nokuginya ukutya okungcolisiweyo. Kwiimeko ezingxamisekileyo zenyukliya, kufuneka kuzalisekiswa iiseti ezimbini zeemfuno;

- limfuneko zokusebenza (impendulo); kunye
- limfuneko zokulungiselela izakhiwo (ulungiselelo).

limfuneko zokuphendula ngokusebenzayo zibhekisa “kubuchule” bokwenza umsebenzi. “Ubuchule” buquka ukuba negunya kunye noxanduva olufunekayo, umbutho, abasebenzi, iinkqubo, izibonelelo, izixhobo, kunye noqeqesho lokwenza umsebenzi okanye umsebenzi ngokufanelekileyo xa kufuneka ngexesha likaxakeka. Kukwabandakanya nokuba neziseko eziyimfuneko ezifunekayo ngexesha likaxakeka. Iziseko ezingundoqo kule meko zithetha uthutho kunye nonxibelelwano, imisebenzi yemizi-mveliso kunye nazo zonke izixhobo umntu anokuzidinga ukuze amalungu oluntu aphume kwindawo echaphazelekayo ngokukhawuleza nangokukhululekileyo kwixesha elifutshane kangangoko. limfuno ezithile ekufuneka umfaki-sicelo azithobele ukubonisa inkqubo ye-EP yokwenzeka zishwankathelwe kwimigaqo ye-NNR siting R.927[1] kunye ne-PP 0015 [25].

Njengoko kuchaziwe kwimimiselo yesiza, ukuchongwa kunye nokugqitywa kwee-EPZ kuqwalasela iimpawu zendawo, ulwazi loyilo lwe-reactor, uqikelelo lwamagama omthombo (ubungakanani, ukwakheka, ixesha, kunye nobude bokukhululwa kwe-radioactivity) kwingozi nganye eqwalaselwayo. Ukubalwa kweedosi eziqikelelweyo ngaphandle

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kwendawo ezivela ekukhutshweni kusekelwe kulwazi oluthile lwendawo okanye oluqhelekileyo kunye nedatha yamva nje yemozulu kunye neyabantu baloo mmandla. Uhlalutyo lwempembelelo yempilo ye-radiological luza kuqwalasela ubudala beqela elichaphazelekileyo.

12.2 Isiseko sokusebenza kwesicwangciso sokulungiselela imeko engxamisekileyo kunye nokuphendula

Isiseko/umlinganiselo wokuba isicwangciso sengxakeko siyasebenza kukuba intlangano yokusabela ngokukhawuleza efana nolawulo lweentlekele lwephondo nolwesizwe iyakwazi ukuphendula ngexesha elimiselweyo ukuthintela iziphumo zempilo ezingafanelekanga ngenxa yokuchatshazelwa yimitha. Oku kuthetha ukuba akufuneki kubekho iimeko ezimbi kwindawo ezinokuthintela indawo yokuhlala okanye ukufuduka kwabantu kulo mmandla okanye ukungena okanye ukuphuma kweenkonzo zangaphandle ezifunekayo ukujongana nengxakeko. Ubungakanani babantu kwi-EPZ akufuneki budlule kwinqanaba elimiselweyo elithintela ukusebenza kwesicwangciso sengxakeko kunye nesicwangciso sokuphendula. Ezinye izinto ezibalulekileyo ezithathelwa ingqalelo ekumiseleni ukuba kunokwenzeka kwesicwangciso sengxakeko zezi:

- Umgama wendawo ukusuka kwiindawo ezinabantu abaninzi;
- Amaqela akhethekileyo abantu abanzima ukuphuma okanye ukufihla, njengabantu abasezibhedlele, kumakhaya abantu abadala, ezikolweni, okanye kwiintolongo;
- Iimpawu ezithile zejografi ezifana neziqithi, iintaba, kunye nemilambo ezinokuba nefuthe ekufudukeni kwemigudu yokukhupha umoya kunye nokukhupha umoya kwaye emva koko ngenxa yengozi yemitha;
- Iimpawu zothutho loluntu kunye nonxibelelwano lwasekuhlaleni;
- Izibonelelo zoshishino ezinokubandakanya imisebenzi enokuba yingozi;
- Imisebenzi yezolimo enovelwano lokukhutshwa kwee-radionuclides;
- Iziganeko zangaphandle ezinokwenzeka ngaxeshanye; kunye
- Iimeko zemozulu ngexesha lengxakeko.

Iindidi ezahlukeneyo zokhuselo zibandakanyiwe kuyilo lwe-NPS ukuthintela iingozi. Ingcamango yoyilo olunjalo olunenani leendidi zokhuseleko lubizwa ngokuba lukhuselo olunzulu. Kuphela xa iimeko zengozi ezibi kakhulu zenzeka ngenxa yokungaphumeleli kweendidi ezininzi zokhuselo, apho kunokwenzeka khona ukukhululwa kwe-radioactivity kwindawo engaphandle. Indidi yokugqibela yokhuselo ukukhusela abantu sisicwangciso sengxakeko.

Idatha yokufaka kuyilo lwesicwangciso sokulungela nokuphendula ngengxakeko ziingozi eziqatha ezicingelwa ukuba zezo zakhiwo zidibene nezifundo ezifunyenwe kwiingozi zokwenyani ezenzeke kwiilabathi ezifana neengozi zenyukliya zaseThree Mile Island (TMI), eChernobyl, naseFukushima, kunye neengozi zenyukliya ezivela kwizityalo zamandla ezingezizo ezenyukliya.

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12.3 Iindawo zoCwangciso lweNgxakeko

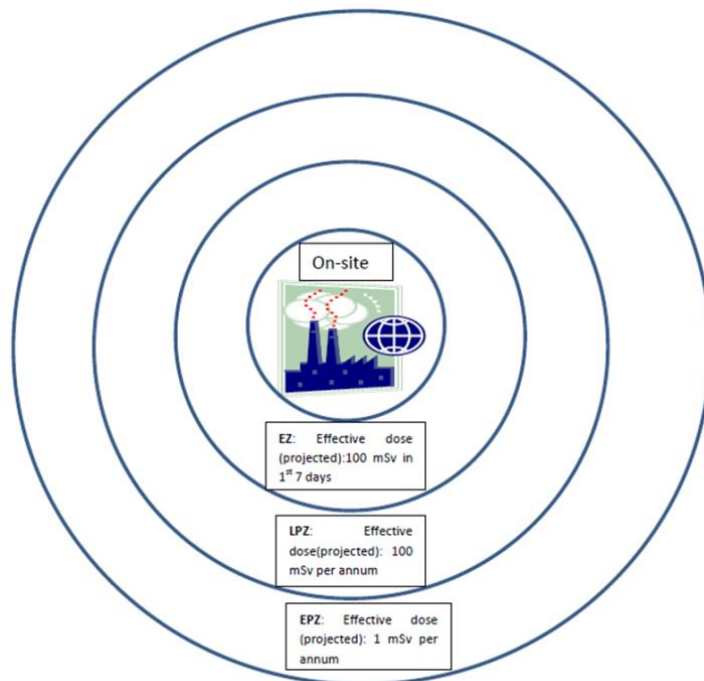
Yinto eqhelekileyo yamazwe ngamazwe ukuba kumiselwe ii-EPZ ezintathu ezenziwe ngeesangqa ezintathu zeeradii ezahlukeneyo ezijikeleze i-reactor. Ekumiseleni i-EPZ, kufuneka kusetyenziswe ezi ndlela zilandelayo ekuchazeni iindawo ezifunekayo (jonga kuMfanekiso 37):

- EZ: Idosi esebenzayo (eqikelelweyo) ye-100 mSv kwiintsuku ezi-7 zokuqala;
- LPZ: Idosi esebenzayo (eqikelelweyo) ye-100 mSv ngonyaka; kunye
- I-EPZ iyonke: Idosi esebenzayo (eqikelelweyo) ye-1 mSv ngonyaka

Imitha yee-EPZ ezahlukeneyo ibalwa ngokusebenzisa igama lomthombo we-radioactive ukusuka kwingozi enzima ecingelwa ukuba iyingozi, ebizwa ngokuba yimeko yengozi ye-radiological ukuthintela umngcipheko wempilo ye-radiological. Ingozi yereferensi imiselwa ngokuvavanya zonke iingozi ezilinganise ipesenti ephezulu yeengozi ezinzima kunye nepesenti ephezulu yomngcipheko ohambelanayo. Ke ngoko, ekubeni iingozi ezinamathuba aphezulu zingaguquleli kwiingozi ezinomngcipheko ophezulu, kwenziwa uphando olubanzi ukuze kufunyanwe indawo apho ubunzima bengozi bulingana khona nomngcipheko. Kwii-PWR ezininzi zeSizukulwana sesiBini, ingozi yereferensi ifunyenwe ilinganise i-98% yeengozi ezinzima ngokuphindaphindiweyo kwe-1 kwiminyaka eyi-1000 (10-6 ngonyaka) kwaye ilinganise i-72% yomngcipheko.

Ukuvavanya nokukhetha ukwamkeleka kobuchwepheshe, kuya kusetyenziswa umlinganiselo ofanayo kunye ne-envelope ye-plant parameter (PPE). Uvavanyo aluyi kusekelwa kuphela kwixabiso/ukufikeleleka kunye nemigangatho yoyilo, kodwa luya kuqinisekisa ukuba ubukhulu bee-EPZ buyanele ukuze ukusebenza kwe-reactor kungabi yingozi engafanelekanga kumalungu oluntu. Injongo yemida kukufezekisa ezi njongo zilandelayo:

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Umfanekiso 42: Ulwalamano Phakathi Kweendawo Ezahlukeneyo Ezingqongileyo Kwisitya Samandla Ehlukileya (Ngokuvumelana Ne Pp-0015) [25]

- Isenzo esincinci sokhuseleko olungxamisekileyo ngaphaya kweemitha ezingama-800 ukusuka kwi-reactor ukuba ingozi ibangele ukukhululwa kwangoko kwe-radioactivity emoyeni ukusuka kwisakhiwo sokukhusela i-reactor;
- Akukho senzo silibazisekileyo njengokufuduselwa kwabantu okwethutyana nangaliphi na ixesha ngaphaya kweekhilomitha ezi-3 ukusuka kwi-reactor;
- Akukho senzo sexesha elide esibandakanya ukuhlaziywa okusisigxina (okungaphezulu konyaka omnye) koluntu nangaliphi na umgama ongaphezulu kweemitha ezingama-800 ukusuka kwi-reactor;
- Uthintelo ekusetyenzisweni kokutya nezityalo kufuneka luthintelwe ngokwexesha kunye nommandla womhlaba ukuze kuncitshiswe impembelelo yezozoqoqosho.

Ukuvavanya ukwamkelwa kobuchwepheshe obucetywayo be-EPR kunye ne-AP1000, kwenziwe uVavanyo lweNgcipheko/uKhuseleko olunokwenzeka (i-PRA / i-PSA) kusetyenziswa iimpawu zesiza kunye nolwazi oluchanekileyo lwegama lomthombo ukumisela iingozi kuluntu nakubasebenzi kwindawo yaseThyspunt ngenxa yokukhululwa okunokwenzeka ngenxa yengozi enkulu. Izigqibo ezivela kolu phononongo zezi zilandelayo:

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- Iingozi zesikhululo ezilindelekileyo zonyaka ngenxa yeengozi ze-reactor kubemi abakwi-50 km radius ejikeleze indawo zithathwe njengezikwimida yomngcipheko we-NNR.
- Iikhrayitheriya zokhuseleko kunye nokuthambekela kwiingozi ezinkulu kuye kwaneliswa kwi-PSA yobubanzi obulinganiselweyo.
- Nangona uphando belulinganiselwe kububanzi kwaye lungelulo lonke ulwazi oluphathelele indawo, luthathwa njengolwanelelo kwinqanaba lokufumana ilayisenisi yendawo logama nje uyilo lwe-reactor olukhethiweyo luneempawu ezifanayo okanye ezifanayo ne-EPR kunye/okanye i-AP1000. Apho idatha yokufaka ethile yendawo yayingafumaneki, kwenziwa iingcinga ezilondolozayo.

12.4 Amanyathelo Okuchasana Nokungxamisekileyo

Ukuphunyezwa kwamanyathelo okukhusela angxamisekileyo kusekelwe kumanqanaba okungenelela aqhelekileyo (ii-GIL), angamanqanaba okuphunyezwa kwaloo manyathelo okumelana nawo. Ezi zishwankathelwe kwiTheyibhile Itheyibhile 14 kunye nesenzo sazo sokukhusela. Kubalulekile ukukhankanya ukuba amaxabiso e-GIL adweliswe ngezantsi awafani neemfuno zolawulo lwenyukliya zaseMzantsi Afrika; afunyenwe yi-International Atomic Energy Agency (IAEA) kwaye asetyenziswa kwiilabathi liphela.

Itheyibhile 14: Izenzo Zokhuseleko Namaqanaba Azo Okungenelela Okufanelekileyo

Isenzo soKhuseleko	Inqanaba loNgenelelo oluQhelekileyo	Ubude bexesha lokuvezwa	Injongo yoMgama we-EPZ, km
Indawo yokukhosela	10 mSv	Iintsuku ezi-2	0,8
Ukukhutshwa kwabantu	50 mSv	Iintsuku ez-7	0,8
Iodine prophylaxis	100 mGy	—	0,8
Ukufuduka okwethutyanana	30 mSv kwiintsuku zokuqala ezingama-30 kunye 10 mSv kwiintsuku ezilandelayo ezingama-30		3
Ukuhlaliswa kwakhona ngokusisigxina	1 000 mSv	Ubomi bonke	0,8
Ukuthintelwa/ukutshintshwa kokutya			40

12.5 Ukwamkela Imbeko Ngokusebenza Kweendlela Zokukhusela Ezikhuselekileyo

Kuye kwangqinwa ukuba xa amanyathelo okukhusela esetyenziswa ngexesha, kukho ukuncitshiswa kwedosi apho amalungu oluntu achaphazeleka khona. Ukuncitshiswa kwedosi kuxhomekeke kungenelelo oluthatyathiweyo kunye nexesha oluqaliswe ngalo emva kokwaziswa ngengxakeko.

Ukuqinisekisa ukuba iziphumo ze-PSA ziyimbonakaliso egciniweyo yemiphumo ye-radiological eyenzeka kwindawo nangaphandle kwindawo ngenxa yokukhululwa ngengozi, kuqwalaselwe ezi ngcamango zilandelayo:

- Akukho ndumiso ithathweyo ngezenzo zokunciphisa uxinzelelo kwindawo leyo eziza kubhalwa kwizikhokelo zolawulo lweengozi ezinzima kwinqanaba lokusebenza.

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- Akukho manyathelo okumelana nesicwangciso sengxamiseko (indawo yokukhusela, ukufuduka, kunye nokuthintela i-iodine), ngaphandle kokuvalwa kokutya, athatyathiweyo.

12.6 Ulawulo lweZinto zokutya: Amanqanaba eZenzo eziQhelekileyo

Ulawulo lokutya namanzi lunokufuneka luqaliswe ukuze kuthintelwe amalungu oluntu ekutyeni ukutya okungcolisiweyo. Iimeko ezichaphazela isigqibo sokuba kuqaliswe na amanyathelo anjalo okulwa, zinokwahlulwa zibe ziindidi ezintathu: ukufumaneka kwezinye izinto; apho ezinye izinto zinqongophele khona; kunye nokusasazwa kurhwebo lwamazwe ngamazwe. Ulawulo okanye ukurhoxiswa kokutya ekusetyenzisweni kwenziwa xa i-radioactivity yeqela elithile lee-isotopes kudidi oluthile lwezinto zokutya ifikelele kwinqanaba elimiselweyo le-radioactivity; kwaye eli nqanaba le-radioactivity laziwa njenginqanaba lesenzo eliqhelekileyo (GAL). Amanqanaba esenzo eliqhelekileyo amiselwe ukusetyenziswa ziigunya zesizwe xa kukho ezinye izinto zokutya ezikhoyo adweliswe kwi-ltheyibhile 15. Njengoko kutshiwo, amaxabiso e-GAL axhomekeke kuhlobo lokutya kunye nohlobo lwe-radionuclide engcolisayo. Ii-radionuclides ezithethwayo zezona zinokubangela inkxalabo ekutyeni emva kwengozi. Kwiimeko apho imiqathango emininzi kwizibonelelo zokutya inokubangela ukunqongophala kwesondlo okanye, xa kugqithisile, indlala, kuya kufuneka uvavanyo lwemeko ngemeko. Kwiimeko ezininzi ezinjalo, kuya kuboniswa ukufuduswa kwaye ukutya okanye kwenziwe kufumaneke. Nangona kunjalo, xa oku kungenzeki, ingozi yemitha kufuneka iqwalaselwe ngokwenyani xa kuthelakiswa neengozi zempilo ezikhuphisanayo, kwaye kufuneka kuthathwe amanqanaba aphezulu esenzo rhoqo. Emva kwaso nasiphi na isiganeko esinokungcolisa ukutya, amanyathelo ahlukeneyo okulwa anokuqaliswa kumanqanaba ahlukeneyo emveliso kunye nokuthengisa. Oku kufuneka kuphunyezwe ukuqinisekisa ukuba, kangangoko kunokwenzeka, ukutya kugcinwa ngaphantsi kwamanqanaba esenzo. Amanqanaba esenzo aqhelekileyo kwiindawo zokutya aya kwanelisa iimfuno zokusasazwa kokutya kurhwebo lwamazwe ngamazwe ukuze kusetyenziswe kumazwe angachaphazeleki yingozi.

Iziphumo zibonisa ukuba amanyathelo engxamiseko kwiitekhnoloji ezimbini zereferensi ye-reactor aya kunqunyulwa. Akukho manyathelo engxamiseko exesha elifutshane angaphandle kwendawo aya kufuneka ngaphaya komda olawulwa ngumnini we-NPS. Nangona kunjalo, isicwangciso sokugqibela sengxamiseko siya kusekelwa kwii-EPZ ezivunyiweyo yi-NNR.

Ukwenzeka kwesicwangciso sengxamiseko esinokwandiswa nangaphaya kwee-EPZ ezibaliweyo, kuxhomekeke kwiinkalo ezamkelekileyo zendawo ezifana nokungabikho kweemeko ezimbi ezinokuthintela ukungena okanye ukuphuma kweenkonzo zangaphandle ezinokufuneka ukujongana nengxamiseko. Ezi nkalo ziya kuxoxwa ngazo kwicandelo elilandelayo.

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Itheyibhile 15: Amanqanaba Okusebenza Okujwayelekileyo Kwizinto Zokutya

Ukutya okulungiselelwe ukusetyenziswa ngokubanzi		
Iqela le-Isotope	I-Radionuclide	Inqanaba lesenzo eliqhelekileyo (GAL) [kBq/kg]
1	^{134}Cs , ^{137}Cs , ^{103}Ru , ^{106}Ru , ^{89}Sr , ^{131}I	1
2	^{90}Sr	0,1
3	^{241}Am , ^{238}Pu , ^{239}Pu , ^{240}Pu , ^{242}Pu	0,01
Ubisi, Ukutya kosana, namanzi		
4	^{134}Cs , ^{137}Cs , ^{103}Ru , ^{106}Ru , ^{89}Sr	1
5	^{90}Sr , ^{131}I	0,1
6	^{241}Am , ^{238}Pu , ^{239}Pu , ^{240}Pu , ^{242}Pu	0,001

12.7 Uluhlu lweengxamiseko zenyukliya

Kukho amanqanaba aqhubekekayo okusabela kwisicwangciso sengxamiseko zenyukliya, kuxhomekeke kubunzulu bemiphumo enokubakho yengozi. La ngawa;

- **Isiganeko Esingaqhelekanga:** Isiganeko esingaqhelekanga esibonisa ukuphambuka okungacwangciswanga kwimisebenzi eqhelekileyo, iziphumo zangempela okanye ezinokubakho ezifuna isaziso somlawuli wexesha likaxakeka kunye nokusebenza kwezinto ezifanelekileyo zesicwangciso sexesha likaxakeka zenyukliya.
- **Isilumkiso:** Kukho imeko enokuthi ikhule ibe yindawo okanye imeko kaxakeka ngokubanzi kwaye ke ngoko ifuna isaziso sabo bonke abasebenzi bexesha likaxakeka ukuze kufunyanwe imeko yokulungela ukuphendula.
- **Imeko kaxakeka kwindawo:** Kukho imeko kaxakeka ebangela ingozi enkulu yemitha kwindawo kodwa ingabi nangozi enkulu yemitha ngaphaya komda wokukhutshelwa ngaphandle koluntu.
- **Imeko kaxakeka ngokubanzi:** Kukho imeko kaxakeka ebangela, okanye enokubangela, ingozi enkulu yemitha ngaphaya komda wokukhutshelwa ngaphandle koluntu.

Uhlalutyo lokubonisa ukuba isicwangciso sengxamiseko siyasebenza kufuneka luqwalasele iimpawu zendawo efanelekileyo kuvavanyo loyilo, ukubalwa komngcipheko kunye nomthamo, iziganeko zangaphandle, idatha yemozulu, ukusetyenziswa komhlaba, amanani abantu, uphuhliso lwengingqi, kunye noqikelelo lwedatha engentla ehambelana nobomi boyilo lofakelo lwenyukliya.

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13. INDLELA YOKULAHLA IMVELISO ENEMITHA ENOBUNGOZI ESEBENZILEYO KUNYE NESICWANGCISO SOKUVALA IZIKO

13.1 Amalungiselo Olawulo Kunye Nokulahlwa Kwemveliso Esebenzileyo Enemitha Enobungozi Yenyukliya

Imveliso esebenzileyo enemitha enobungozi yenyukliya iza kuphathwa ngokwemigqaliselo ye-

Umgqo-nkqubo kunye necebo loLawulo loMququzeleli we-Radiactive kwiRiphabhlikhi yaseMzantsi Afrika ka-2005 [3]

I-NNR ilawula zonke izinto ezinxulumene nenyukliya kunye nendlela yokuphatha imveliso esebenzileyo enemitha enobungozi yenyukliya ngokomsebenzi wayo ewugunyazisiwe ocaciswe kwi-National Nuclear Regulator Act (1999) [36]. Ngokwe-Nuclear Energy Act (1999) [35], iqumrhu elinamagunya okuba liliso kwimveliso esebenzileyo enemitha enobungozi yenyukliya kunye namafutha esiphehli-nyukliya asebenzileyo nguMphathiswa wezaMandla.

Umthamo wemveliso esebenzileyo uza kuxhomekeka kuhlobo elisebenza ngalo iziko elo lombane. Eli liziko lombane licetywayo, elifanayo ne-KNPS, liza kukhupha imveliso esebenzileyo ekumgangatho ophantsi (LLW), ekumgangatho ophakatho (ILW), kunye nekumgangatho ophezulu (HLW). I-LLW kunye ne-ILW zine-radioisotopes ezibola ngokukhawuleza xa kubalwa ngokwamaxesha akwanyukliya (i-LLW zithatha iminyaka enokufike kwengama-30 zize kwi-ILW).

13.2 I-Vaalputs, Isiza Sokulahlwa Imveliso Esebenzileyo Enemitha Enobungozi Yenyukliya

Ngokwe-National Radioactive Waster Manangement Policy and Strategy, i- Vaalputs Radioactive Waste Disposal Site eseMntla Koloni, liziko elakhelwe ukulahlala i-L&ILW eMzantsi Afrika. IVaalputs yakhiwe futhi yanikwa imvume yokuba ifake ukuxhaka-xhaka obaneleyo ukuze ikwazi ukwamkela i-L&ILW evela e-KNPS nakulo naliphi na iziko (amaziko) elitsha lokuphehla inyukliya. Indlela yokutshabalalisa le mveliso isebenzileyo enemitha enobungozi yenyukliya yenziwe ngokuthi kusetyenziswe amagunya enyukliya anikezwel yi-NNR phantsi kwe-National Regulator Act, 1999 (Act No. 47 of 1999) [36].

Ngaphambili, iVaalputs, iziko lokutshabalalisa imveliso enemitha enobungozi yenyukliya, yayikade iphantsi kwe-South African Nuclear Energy Corporation (NECSA) eyayinoxanduva loku

Umsebenzi ka-NECSA uza kunikwa i-National Radioactive Waster Disposal Institute eyasekwa njengequmrhu elizimeleyo ngumthetho phantsi kwecandelo 55(2) le-Nuclear Energy Act (No. 46 of 1999) [35] kunye ne-National Radioactive Waster Disposal Institute Act, (No. 53 of 2008) [37] ukuze yenze umsebenzi osemgangathweni ophezulu wokuTshabalalisa okanye ukuLahlwa iMveliso ezineMitha enobuNgozi beNyukliya, i-Nuclear Waste Management and Disposal Services in South Africa egameni likarhulumente.

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13.3 Isicwangciso Sokuvala Iziko

Xa iziko lokuphehla inyukliya lifikele kwisithuba apho sele lingasakwazi umsebenzi lifuna ukutshitshiswa, ixesha elo limalunga neminyaka engama-60, liza kutshitshiswa, livalwe. Ngokwe- RD-0026 [23], ukuvalwa kweziko kuchazwa njengeniyathelo elithathwa ngabalawuli nazingcali elivumela ukuba kususwe yonke imithetho ibilawula iziko (ngaphandle kwecandelo elinolwazi elingavalwa kwaye elingatshitshiswa). Kumaziko okuphehla inyukliya, ukutshitshisa linqanaba lokugqibela elo ziko lisebenza emva kokuhlolwa kwesiza, ukuzotywa kwesicwangciso sokwakha, ukwakha, ukunikwa imvume yokusebenza, ize ibe kukusebenza. Ngumsebenzi onzima kakhulu lo oquka ukwenza izinto ezifana nophando elinika iinkcukacha ngemitha enobungozi yenyukliya, ukucocwa, kunye nokuqhaqhwa kweziko, izixhobo nezakhiwe, ukudilizwa kwezakhiwo neentsimbi, ukuphinda kulungiswe isiza, kwakunye nokulahla bonke ubugoxo. Zonke izinto ezenziwayo kweli nqanaba zenziwa ngokomthetho obekiweyo kwaye zigunyaziswa yi-NNR (funda kwi-RD-0026) [23] ekuthathela ingqalelo ukubaluleka kwempilo nokhuseleko lwabasebenzi abenza lomsebenzi, uluntu ngokubanzi kunye nokukhuselwa kokusingqongileyo.

Isicwangciso sokutshitshisa iziko eziqulunqwe kulandelwa u- -RD-0026 [23] siza kungeniswa ku-NNR njengenxalenye yesicwangciso esisacetywano sokutshitshisa iziko kwakwinqanaba lokwenza isicwangciso somzobo wokwakha kwaye siza kumana sihlaziya minyaka le iziko lisasebenza lisenza umsebenzi ogunyazisiweyo njengesikhokelo sesicwangciso esityebileyo sokutshitshisa iziko.

Isicwangciso sokutshitshisa eli ziko lokuphehla inyukliya licetywayo singafana nesicwangciso saseKoeberg Nuclear Power Station. Esi sicwangciso sinika ingcaciso ngezi zigaba zingundoqo zokutshitshisa iziko:

Isigaba 1: Amalungiselelo

Esi sigaba siza kuqalisa kwisithuba esiyiminyaka esixhenxe phambi kokuba livalwe iziko lokuphehla inyukliya. Siyakuqala uluhlu olucacileyo lwamalungiselelo (umz., ukubhalwa koluhlu lwezikhundla zeqela leprojekthi yokuvala iziko), amaphulo ophando (umz., uhlolo lomonakalo owenzeke kokusingqongileyo, uphando olujonga ukuphumelela koku olungatyabuliyo ngemali, ukwenza uluhlu lwemithamo yemveliso enemitha enobungozi eza kugcinwa, iindlela zokulawula, ukuhlelwa kweentlobo zemveliso esebenzileyo, kuquka uqikelelo lohlobo lwemveliso esebenzileyo, umthamo kunye neendawo ezikuyo i-*radionuclides* ezibalulekileyo xa iziko sele liyekile ukusebenza, njl njl), iinkqubo kunye neenkcukacha ngobugcisa (umz. ukuvalwa kunye neendlela zokukhupha amafutha esiphehli-nyukliya, amalungiselelo okukhusela abasebenzi bangonzakaliswa yimitha enobungozi yenyukliya, ukulawulwa nokukhutshwa kolwelo negesi esebenzileyo, ukutshatyalaliswa kwemveliso ezinemitha enobungozi yenyukliya, ukugadwa kweli ziko, iinkqubo zikaxakeka kunye nokhuseleko lwabasebenzi abalapha), kunye nokwakhiwa kweziko lethutyana eliza kuncedisa ngeli thuba kudilizwayo kuqhaqhwa (umz., indawo enye eza kwenza umsebenzi wokuba liliso xa kuthathwa izixhobo zokusebenza kusenziwa

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namalungiselelo ezinto eziza kulahlwa kwindawo engekho apha ngaphakathi kweli ziko, ukulungiswa kweendlela eziza kuhamba izigadlal ezilayishe imithwalo, ukwenza iindawo zokukhusa ngoku kulayishwa kuthuthwa izinto, ukwakhiwa kwamazikwana okucoca, kunye nokuthengwa kwezixhobo zokwenza imisebenzi efuna ubuchule obuthile.)

Isigaba 2: Ukuvalwa kwefektri kunye nokususwa kwepetroli

Izigqibo zenziwa malunga nemihla yokugqibela yokuvalwa kweeyunithi (oko kukuthi emva kweencopho zasebusika okanye kwinqanaba elifanelekileyo lokusetyenziswa kwamafutha) kwaye isicwangciso sokugqibela sokuvalwa kwesityalo kunye nokususwa kwamafutha siyaphunyezwa.

Isigaba 3: Sebenzisa isicwangciso sokwahlulahlula ukupholisa ichibi lamafutha elisetyenzisiweyo

Nje ukuba ipetroli idluliselwe kwichibi lamafutha elisetyenzisiweyo, isicwangciso sokwahlula ichibi lamafutha elisetyenzisiweyo siyasebenza ukuseka inkqubo yokupholisa ichibi lamafutha elisetyenzisiweyo elizimeleyo.

Isigaba 4: Imisebenzi yokuvala iziko

Esi sigaba siquka le misebenzi ilandelayo:

- Ukudilizwa kwesiqithi esinguzenzele nezakhiwo zokuncedisa
- Amalungiselelo egumbi elikhuselekileyo; kunye
- Nokuqhawulwa kweentambo zombane.

Isigaba 5: Ukususwa kwamafutha asetyenzisiweyo kunye nokudilizwa kwesakhiwo samafutha kunye nezixhobo ezincedisayo ngombane

Emva kokuhlala iminyaka eli-10 kwitanki lokugcina amafutha, la mafutha okugqibela ebegalelwe apha kufanele ukuba ngoku aphole ngokwaneleyo ukuba angakhutshwa kweli tanki. Amafutha asebenzileyo aye akhutshwe asiwe kwitanki lokugcina amafutha nelokuwahambisa ukuze alungelwe ukuthuyelwa kwitanki elikhulu lesizwe. Akuba ekhutshwe onke amafutha ematankini, iziko lingaqaliswa ukucocwa livalwe ngokwezicwangciso.

Isigaba 6: Ukudilizwa kwezakhiwo ezisele kunye nokuvuselelwa kwendawo

Ukudilizwa kwezakhiwo ezingabalulekanga kakhulu kuza kuqala akuba amafutha onke ethuthiwe. Iindawo zesiza eziza kuchatshazelwa ngumsebenzi wokudiliza ziza kucocwa ize le ndawo ibinesiza ivunguzwe ngoogandaganda ukuthintela ukuba igangatheke ngolo hlobo kube nzima ukugrumba nokukhupha ubugoxo obuphantsi komhlaba.

Iinkcukacha ezingqalileyo sesicwangciso sokuvala iziko azaziwa okwangoku, ziza kuqukunjelwa sakuba senziwe isicelo sokuvalwa ngokusesikweni kweziko lokuphehla inyukliya.

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14. UKUTHUTHWA KWEMVELISO ESEBENZILEYO ENEMITHA EYINGOZI YENYUKLIYA

UMzantsi Afrika ulilungu le-International Atomic Energy Agency (i-IAEA) ke ngoko usebenzisa imigaqo yezothutho ecaciswe kwi-IAEA (funda kwi-IAEA *Safety Requirements No. TS-R-1* kunye ne-*Specific Safety Requirements No SSR-6*) ngeendlela zokuthuthwa ngokukhuselekileyo kwemveliso enemitha enobungozi yenyukliya efana namafutha esiphehli-nyukliya, imveliso esebenzileyo enemitha enobungozi yenyukliya ekudidi olusezantsi noluphakathi, kunye nentlenga yezimbiwa. Le mithetho ifakwe kwimithetho yoMzantsi Afrika (funda kwi- RG-0007 [27]: *Regulatory Guide on Management of Safety*, RG-0008 [28]: *Regulatory Guide on General Transport, and the General Nuclear Safety Regulations (DRAFT)*). Kufuneka kucelwe imvume kwi-NNR egunyazisa ukuthutha nayiphi na imveliso esebenzileyo enemitha enobungozi yenyukliya. Le mvume iquka isicelo selayisenisi yesithuthi senyukliya ukuze sikwazi eso sithuthi ukulayisha amafutha esiphehli-nyukliya isuke kwinkampani eyivelisayo iye ezibukweni elikufutshane neziko lokuphehla inyukliya.

Injongo yokwamkela imithetho yezothutho ye-IAEA nokuyenza inxalenye yemithetho yoMzantsi Afrika “...kukukhusela abantu, ipropati kunye nokusingqongileyo kumonakalo owenziwa yimitha enobungozi ngethuba kuhanjiswa ngesithuthi imveliso enemitha enobungozi yenyukliya...”. Oku kwenzeka ngokuthi kwenziwe iziphakamiso ezimayelana namatanki okufaka le mveliso isebenzileyo, indlela yokuyikhusa, kunye nokuthintela.

Amafutha esiphehli-nyukliya aza kuhanjiswa ngolwandle kwimigqomo okanye amatanki omeleleyo eyenzelwe kanye lo msebenzi asiwe kwizibuko elikufutshane njengaxa kulayishwe imithwalo emikhulu kakhulu ngokwemithetho ye-IAEA kunye neye-NNR enika ingcaciso ngendlela yokuhambisa ngezithuthi amafutha esiphehli-nyukliya. I-NNR yiyo edlala indima yokubeka iliso lokuqinisekisa ukuba le mithetho iyathotyelwa ngokuthi iqhube amaphulo okuya kuhlola rhoqo futhi yenze nophando. Kwihlabathi akukho ziganeko zazizibi zakhe zenzeka oko kwaqaliswa ukuhanjiswa imveliso enemitha enobungozi yenyukliya, ngenxa yamalinge enziwayo kunye nemali eninzi ebhatalwayo ukuqinisekisa ukhuseleko lukhokela phambili.

Imveliso esebenzileyo enemitha enobungozi yenyukliya (ekumgangatho osezantsi nophakathi) ephuma kwiziko lokuphehla inyukliya iza kuthuthelwa eVaalputs Radioactive Waster Disposal Site. Izicwangciso ezikhoyo zicebisa ukuba ihambe ku -N7 iye eVaalputs.

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15 ISIPHELO

Olu xwebhu lunika uluntu iinkcukacha ezigcweleyo ngale projekthi; imithetho u-Eskom ekufuneka achankathe kuyo aze ayithobele phambi kokuba imvume esisigunyaziso selayisenisi yeziko lokuphehla inyukliya (i-NISL) kunye ne-NIL ifunyanwe (njengoko ezi izinkqubo ezimbini ezahlukeneyo). Njengoko sekutshiwo ngaphambili, i-NIL sisigunyaziso esingundoqo esivumela ukuba kwakhiwe, uqalise umsebenzi, kulungiswe, kuzo kuze kuvalwe iziko lokuphehla inyukliya ngokobuchwepheshe obuthile. I-PID ehamba nesicelo se-NIL iza kubhalwa sakuba senziwe sicelo se-NIL.

Enziwe onke amalinge okuqinisekisa ukuba uluntu lufumana ulwazi olubalulekileyo olumalunga nohlobo lwesigunyaziso se-NISL esifakelwa isicelo kunye neengozi ezi hamba naso. Bunikiwe ubungqina obubonisa ukuba zonke izinto eziyingozi ezinokubangela i-*ionising radiation* zixeliwe nokuba ezi zinto zingagcinwa zi-ALARA. Ke ngoko kungaqukunjelwa ngelithi isiza esiseThyspunt sichazwe kakuhle xa kusithiwa sisiza esifanelekileyo sokwakha iziko (amaziko) elitsha lokuphehla inyukliya.

PUBLIC

ISIHLOMELO A: IZIKHOKELO, IIKHOWUDI NEMIGANGATHO YAMAZWE NGAMAZWE

Izifundo zophando lwendawo yaseThyspunt zithathele ingqalelo imigangatho efanelekileyo yokhuseleko lwamazwe ngamazwe kunye neengcebiso, kunye nezifundo ezifunyenweyo kunye neyona ndlela ilungileyo evela kumazwe anamava kwicandelo lovavanyo lwendawo kunye nophuhliso lweendawo ezintsha zenyukliya. Imithombo ephambili eqwalaselweyo idweliswe ngezantsi.

Izikhokelo, iikhowudi, kunye nemigangatho ye-International Atomic Energy Agency (IAEA)

- Imigaqo yoKhuseleko oluSisiseko, iZiseko zoKhuseleko No. SF-1
- Uvavanyo lweNdawo yoFakelo lweNyukliya, uLuhlu lweMigangatho yoKhuseleko No. SSR-1
- Ukusasazeka kwezinto ezinemisebe emoyeni nasemanzini kunye nokuqwalaselwa kokusasazwa kwabantu kuVavanyo lweNdawo lweZityalo zaMandla eNyukliya, uLuhlu lweMigangatho yoKhuseleko No. NS-G-3.2
- Uyilo loFakelo lweNyukliya ngokuchasene neSiganeko sangaphandle ngaphandle kweNyikima. uLuhlu lweMigangatho yoKhuseleko, uLuhlu lweMigangatho yoKhuseleko No. SSG-68
- Iingozi zeMeteorological kunye neHydrological kuVavanyo loFakelo lwaMandla eNyukliya. uLuhlu lweMigangatho yoKhuseleko No. SSG-18
- Iingozi ezinxulumene neZiganeko zangaphandle ezibangelwa ngabantu kuVavanyo lweNdawo yoFakelo lweNyukliya. Uthotho lweMigangatho yoKhuseleko Inombolo SSG-79
- Uyilo lweNyikima yoFakelo lweNyukliya, Uthotho lweMigangatho yoKhuseleko Inombolo SSG-67
- Iingozi zeNyikima kuVavanyo lweNdawo yoFakelo lweNyukliya. Uthotho lweMigangatho yoKhuseleko Inombolo SSG-9
- Iingozi yeNtaba-mlilo kuVavanyo lweNdawo yoFakelo lweNyukliya, Uthotho lweMigangatho yoKhuseleko Inombolo SSG-21
- Iinkalo zeJootechnical zoVavanyo lweNdawo kunye neZiseko zeZityalo zaMandla eNyukliya. Uthotho lweMigangatho yoKhuseleko Inombolo NS-G-3.6
- Ukulawula Imisebenzi yoKwakha iZityalo zaMandla eNyukliya. Ingxelo yoBugcisa Inombolo NG-T-3.7
- Uphando lweNdawo kunye noKhetho lweNdawo yoFakelo lweNyukliya. Uthotho lweMigangatho yoKhuseleko Inombolo SSG-35

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IKomishini yoLawulo lweNyukliya yase-United States (USNRC)

- IKhawudi ye-USNRC 10 yeMigaqo yeSizwe Isahluko 1, Icandelo 100, likhrayitheriya zeSayithi yeReactor
- IKhawudi ye-USNRC 10 yeMigaqo yeSizwe Icandelo 52 (10CFR52) Inkqubo yeeMvume zeSayithi zasekuqaleni, iSatifikethi soYilo oluQhelekileyo kunye neLayisenisi yoKwakha kunye nokuSebenza eDibeneyo
- Isikhokelo soLawulo lwe-USNRC 4.7 kwiikhrayitheriya zokufaneleka kweSayithi ngokubanzi kwiZitishi zaMandla eNyukliya
- Isikhokelo soLawulo lwe-USNRC 1.208 Indlela eSekelwe kuMsebenzi yokuChaza iNkanyamba eKhethekileyo yeSayithi
- Isikhokelo soLawulo lwe-USNRC 1.132. Uphando lweNdawo yeZiseko zeZityalo zaMandla eNyukliya
- Isicwangciso soHlobo oluQhelekileyo lwe-USNRC NUREG-0800 soHlobo lweNgxelo yoHlalutyo loKhuseleko (i-SAR) lweZityalo zaMandla eNyukliya
- Uvavanyo lweNgxaki yeTsunami ye-USNRC NUREG/CR-6966 kwiindawo zeZityalo zaMandla eNyukliya e-United States of America
- Isikhokelo soLawulo lwe-USNRC 1.27 Isinki soBushushu esiPhezulu seZityalo zaMandla eNyukliya
- Isikhokelo soLawulo lwe-USNRC 1.59 Isiseko soYilo lweZikhukhula zeZityalo zaMandla eNyukliya
- Isikhokelo soLawulo lwe-USNRC 1.70 Ifomathi eQhelekileyo kunye nomxholo weeNgxelo zoHlalutyo loKhuseleko lweZityalo zaMandla eNyukliya
- Isikhokelo soLawulo lwe-USNRC 1.206 Izicelo zeLayisenisi eziDibeneyo zeZityalo zaMandla eNyukliya
- Isikhokelo soLawulo lwe-USNRC 1.102 Ukukhuselwa kweZikhukhula zeZityalo zaMandla eNyukliya.

IZiko loPhando lwaMandla oMbane (i-EPRI)

- Ukukhethwa kweNdawo kunye neMigqaliselo yoVavanyo lweZibonelelo eziNtsha zokuVeliswa kwamandla eNyukliya (Isikhokelo sokuVeliswa kweNdawo).

Umbutho Wezizwe Ngezizwe Wokumisela Imigangatho (ISO)

- ISO 9001-2008, linkqubo Zolawulo Lomgangatho – limfuneko
- ISO 14001: 2005, linkqubo Zolawulo Lokusingqongileyo – limfuneko

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- ISO 9225:1992 Ukugqwala Kwesinyithi Nee-Alloys – Ukugqwala Kwemozulu – Ukulinganiswa Kongcoliseko
- ISO 9224:1992 Ukugqwala Kwesinyithi Nee-Alloys – Ukugqwala Kwemozulu – Iixabiso Ezikhokelayo Kwiindidi Zogqwala
- ISO 17025:2005. Iimfuneko Eziqhelekileyo Zobuchule Bovavanyo Nokulinganisa Iilabhoratri

IKomishini Yamazwe Ngamazwe Yokhuseleko Lwemisebe (ICRP)

- Ukuvavanya Idosi Yomntu Omeleyo Ngenjongo Yokukhusela Imisebe Yoluntu: I-ICRP Publication 101, Icandelo 1 (ICRP, 2005).
- Imigaqo Jikelele Yokukhusela Imisebe. Iingxelo ze-ICRP. Impapasho 75 (ICRP, 2006).
- Iingcebiso zika-2007 zeKhomishini Yamazwe Ngamazwe Yokhuseleko Lwemisebe. Iingxelo ze-ICRP, Impapasho 103.
- Ingcamango kunye nokusetyenziswa kweZilwanyana Nezityalo Ezibhekiselele Kuzo, Impapasho ye-ICRP 108.
- Iidosi Ezixhomekeke Kubudala Kumalungu Oluntu Ukusuka Ekutyeni IiRadionuclides: Icandelo 5 Ukuhlenganiswa KweeCoefficients Zedosi Zokungenisa Nokuphefumla. Impapasho 72 Umqulu 26

I-American Nuclear Standards Institute (ANSI)

- Iikhrayitheriya zoPhando lweendawo zeZiko leNyukliya zoVavanyo lweNgozi zeNyikima. I-ANSI/ANS-2.27-2008 esemgangathweni

I-American Society of Civil Engineers (ASCE)

- Iikhrayitheriya zoYilo lweNyikima zeZakhiwo, iNkqubo, kunye neeCandelo kwiZibonelelo zeNyukliya. ASCE/SEI 43-05

Iimigangatho yeSizwe yaseMzantsi Afrika (SANS)

- SANS 241:2006. IKhawudi yokuSebenza esemgangathweni yaseMzantsi Afrika yeNkqubo eziQhelekileyo kunye neMithwalo eza kwamkelwa kuYilo lweZakhiwo

Iimfuneko zeNyikima zaseYurophu (EUR)

- Iimfuneko zeNyikima zaseYurophu zeZityalo zamandla eNyukliya zeLight Water Reactor (LWR)

PUBLIC