5 August 2015

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Our Ref: J31314
Your Ref: Email received 28 July 2011

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Dear Ms McDonald

RE: ESKOM EIA CONCERNS FOR THE PROPOSED NUCLEAR POWER STATION AND ASSOCIATED INFRASTRUCTURE (DEA Ref. No: 12/12/20/944)

Comment 1:

As I read these words out word for word from the document attached I do need you to please correct the minutes where you see fit.

I think there may have been some additional points there which have not been added for example.

In this report, the ICRP linear no threshold model is used to assess risk due to radiation.

Research on "non-(DNA)-targeted" radiation effects prove the inaccuracy of a simplistic linear relationship[i] [ii] especially at low doses.

These effects include radiation-induced bystander effects (Morgan, 2003a; Morgan, 2003b), genomic instability (Wright, 1998; Wright, 2000), adaptive response (Wolff, 1998) and low dose hyper-radio sensitivity (HRS) (Joiner, et al., 2001).[iii] Radiation-induced bystander effect (RIBE), which was found in the 1990s, showed radiation effects to cells which had not been targeted resulting in an affected area that was much larger than anticipated.

Thus scientists are well aware that current risk assessment models such as those employed to assess risks associated with nuclear plant emissions are inadequate for low doses.

Again, the author of this report needs to look a little further than in-house industry literature.

I have attached the document I read from herewith.

Response 1:

Bystander effects are not new. As referenced in EU (2009)[1], there is extensive literature on clastogenic factors and other “compounds” that stimulate or modify responses in cells that were not

[1] EU. 2009. Radiation Protection No 151. EU Scientific Seminar 2005. Alpha Emitters: Reliability of Assessment of Risk for Radiation Protection. Proceedings of a scientific seminar held in Luxembourg on 21 November 2005. Working Party on Research Implications on Health and Safety Standards of

damaged. The relevance of bystander effects to carcinogenic risk has not been determined and acknowledgement of this effect does not "*prove the inaccuracy*" of the current linear-no-threshold hypothesis that is used in radiation protection practice. Research in this field is continuing and findings are interesting. However, these are not sufficient to support a new and completely different paradigm of radiological risk assessment. It must be acknowledged that there is a large volume of radiobiological and epidemiological evidence that is in line with the classical paradigm.

The radiological protection recommendations are accepted and implemented via the South African radiological protection statutes and regulations. The International Commission on Radiological Protection (ICRP) has been functioning since 1928 when it was established. The ICRP is an advisory body that offers its recommendations to regulatory and advisory agencies, mainly by providing guidance on the fundamental principles on which appropriate radiological protection can be based. Since its inception the ICRP has regularly issued recommendations regarding protection against the hazards of ionising radiation. International organisations and national authorities responsible for radiological protection, as well as the users have adopted these recommendations and principles issued by the ICRP as a key basis for their protective actions. As such, virtually all international standards and national regulations addressing radiological protection are based on the ICRP recommendations. Currently, the South African Regulations on Safety Standards and Regulatory Practices R.388 which contains statutory requirements for radiological protection are based on the ICRP 1990 Recommendations in Publication 60.

Compliance to all South African statutes and regulations relating to radiological protection are mandatory and the radiological protection information contained in the EIA relating to ICRP risk models are aligned to provisions and requirements addressed in relevant South African statutes and regulations.

ADDITIONAL COMMENTS FROM INDEPENDENT NUCLEAR SPECIALIST

It should be noted that a fundamental principle of the nuclear and radiological safety is that over and above meeting specific limits the license applicant demonstrate the incorporation of ALARA principles and this reinforces that existing approach.

Epidemiological studies do indicate a statistical link between high level radiation exposure and the risk of excess "cancers" within a study population. Indeed the ongoing studies of survivors of the second world war Japanese atomic weapons continue to inform the basis of radiation protection risk factors and associated exposure limits based on the assumption of the existence of "the linear no threshold" relationship between exposure and risk. However at low exposures associated with occupational and environmental exposure to sources originating from man-made radioactivity this relationship is unproven and remains the subject of intense scientific debate and in particular no direct causality between specific elements such as caesium or their isotopes has been established. However the Radiation Protection community continues to adopt a conservative approach in assuming the linear no threshold model applies in these situations. There have been a number of epidemiological studies undertaken around various industrial facilities including for example studies undertaken around nuclear fuel reprocessing sites which historically had enhanced Cs discharges and also around non-nuclear facilities and which have in some instances indicated statistical "clusters" of excess "cancers" however in general the results and causality remain inconclusive and various theories have been

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the Article 31 Group of experts. Director-General for Energy and Transport, Directorate H – Nuclear Energy. Unit H.4 – Radiation Protection. European Commission.

proposed including those relating to the migratory nature of the workforce and genetic interaction with other non-radiological environmental stressors.

The protection standards and arrangements proposed are not determined by "the industry" - bodies like the ICRP, IAEA, and NNR are independent of "the industry" and base their recommendations and regulations on the best available scientific evidence following extensive discussion and consultation to reach a consensus view and moreover constantly review and update these as new scientifically based information becomes available.

Comment 2:

I am being forced to ask again how any Human health impact assessment can possibly be valid without an assessment of any data.

It is not enough to know that the NNR has done monitoring studies around the existing Koeberg facility. These studies if they have been done need to be analysed independently from the NNR.

These studies should be in the public domain and if they are not the question begs asking - why not?

Response 2:

Thank you, your comment is noted. Please note that the Koeberg annual Radiological Environmental Survey report is available and can be requested in the Koeberg Public safety forums.

Comment 3:

If no independent or peer reviewed studies have been done then how can it be assumed that compliance with the NNR levels will be protective of nearby residents?

Response 3:

Predictions of radiations emissions are based on proven and published sources of radiation emissions from existing nuclear power station in South Africa (Koeberg Nuclear Power Station) and internationally, where it has been demonstrated that radiation doses can be expected from particular designs with particular protective measures having been put in place. Typical radiation dose rates from these technologies are known and are provided in the Nuclear-1 Consistent Dataset (Appendix C of the Revised Draft EIR).

ADDITIONAL COMMENTS FROM INDEPENDENT NUCLEAR SPECIALIST

Again this will be determined definitely as part of the design specific radiological impact assessment, safety case and licensing process - the proposed design will not be a first of a kind technology and therefore there will be a reference design upon which the proposed safety case will be based and which can already demonstrate compliance with international standards.

Comment 4:

Understanding also that emissions both gaseous and liquid are sometimes unavoidable and that the actual levels are difficult to control, on what basis is it assumed that plants will infact comply with NNR emission levels set?

Response 4:

The basis is set on Eskom's experience and continuous successful operation of Koeberg Nuclear Power Station (KNPS), over the past 28 years. y The Eskom KNPS has consistently kept its radiation emissions far below legal limits set by the NNR and other nuclear power stations using similar technology around the world. The NNR published the KNPS's radiation monitoring results in its annual reports.

ADDITIONAL COMMENTS FROM INDEPENDENT NUCLEAR SPECIALIST

Agreed and whilst the Koeberg experience is important as the proposed design will not be first of a kind technology and will be based on established technology there is likely to be a reference plant design and safety case upon which any assumptions would be based.

Emissions from Nuclear Power Plants (NPP's) are not difficult to control as NPP's are designed to keep levels of radioactive material in liquid and/or gaseous effluents as low as is reasonably achievable. Liquid and gaseous effluent discharge pathways are designed for effluents to be collected, stored, processed and filtered, sampled, assessed and monitored prior to discharge in accordance with authorised standards and procedures.

Comment 5:

The EIA is passed then on the assumption that NNR levels will be held on the assumption that these levels are safe.

There is no data to provide any evidence or either of these two assumptions.

An assumption on top of another assumption does not seem like solid ground for an infallible argument.

2. (p 5 in reference to Nagasaki and Hiroshima victims) I would like to ask why more recent literature critically appraising the IRCP standards has not been examined?

Response 5:

Kindly refer to response 4 above. The assumption that NNR levels are safe is based on international benchmarks and peer-reviewed nuclear science that has been established, tried and tested over almost a century. To provide a full explanation of the reasons why nuclear science has determined what are regarded to be safe levels of radiation would require an explanation starting with the very fundamentals of nuclear science. Secondly, as indicated repeatedly in public forums and in EIA documentation, the separation between the EIA process and the NNR licensing process is based on the legislative provisions of the relevant Acts, namely the National Environmental Management Act, 1998 and the National Nuclear Regulator Act, 1999, as well as the DEA / NNR co-operative

agreement, which governs the consideration of radiological issues in EIA processes and the interaction between the DEA and the NNR in terms of their respective mandates for environmental protection and radiological safety (See Appendix B4 of the Revised Draft EIR). The agreement clearly stipulates that issues of radiological safety are within the mandate of the NNR.

ADDITIONAL COMMENTS FROM INDEPENDENT NUCLEAR SPECIALIST

The protection standards and arrangements proposed are not determined by "the industry" - bodies like the ICRP, IAEA, and NNR are independent of "the industry" and base their recommendations and regulations on the best available scientific evidence following extensive discussion and consultation to reach a consensus view and moreover constantly review and update these as new scientifically based information becomes available.

Comment 6:

The EIA report provides absolutely no review of the contemporary discursive peer reviewed literature. On what basis does a review that cites in-house nuclear industry literature from solely the IAEA and ICRP comply with the requirements for an independent EIA?

An example of this literature would be an article by Jacob and colleagues, in the journal Occupational and Environmental Medicine in 2009 present findings that confirm that the cancer risk per dose for low-dose exposures is NOT NECESSARILY lower than for the atomic bomb survivors. They conclude "This result challenges the cancer risk values currently assumed for occupational exposures."

In this report, the ICRP linear no threshold model is used to assess risk due to radiation.

Research on "non-(DNA)-targeted" radiation effects prove the inaccuracy of a simplistic linear relationship[i] [ii] especially at low doses.

These effects include radiation-induced bystander effects (Morgan, 2003a; Morgan, 2003b), genomic instability (Wright, 1998; Wright, 2000), adaptive response (Wolff, 1998) and low dose hyper-radio sensitivity (HRS) (Joiner, et al., 2001).

[iii] Radiation-induced bystander effect (RIBE), which was found in the 1990s, showed radiation effects to cells which had not been targeted resulting in an affected area that was much larger than anticipated.

Thus scientists are well aware that current risk assessment models such as those employed to assess risks associated with nuclear plant emissions are inadequate for low doses.

Again, the author of this report needs to look a little further than in-house industry literature.

Response 6:

Kindly refer to response 1 and 5 above. Furthermore, as we have pointed out in the DEIR, t*he Emergency Response (Appendix E26) and Site Access Control Report (Appendix E27) and Human Health Risk Assessment (Appendix E24), which have been prepared on a high level,, are appended to this EIR for information only. Further details on these reports will be prepared as part of the NNR nuclear licensing process, as their findings will be evaluated by the NNR."*

ADDITIONAL COMMENTS FROM INDEPENDENT NUCLEAR SPECIALIST

The protection standards and arrangements proposed are not determined by "the industry" - bodies like the ICRP, IAEA, and NNR are independent of "the industry" and base their recommendations and regulations on the best available scientific evidence following extensive discussion and consultation to reach a consensus view and moreover constantly review and update these as new scientifically based information becomes available.

Comment 7:

I question again the legitimacy of this EIA. Does this EIA seek to present unbiased findings both negative and positive or does it seek to prove Nuclear-1 compliant on all counts?

Response 7:

Compliance to all South African statutes and regulations relating to radiological protection are mandatory and the radiological protection information contained in the EIA relating to ICRP risk models are aligned to provisions and requirements addressed in relevant South African statutes and regulations.

Comment 8:

Turning from health to the small issue of high level waste.

I enjoyed the touchingly optimistic view that the government should investigate the best long term options for disposing of spent fuel, including

1. reprocessing, conditioning and recycling;
2. geological disposal and
3. "transmutation" however on this the author say that 'transmutation' was unproven and rather unlikely.

Rudimentary research into reprocessing shows it to be very unsatisfactory also - la Hague in France has been found to be extremely costly and far from solving the nuclear waste problem has amplified it; with discharges from this plant significantly more than dry or wet storage would have been over this period.

We know the difficulties with regard to geological disposal with reference to the experiences of various countries, even though the report refers to several national programs that are I quote "within a decade" of operating a geological repository for HLW and spent fuel, notably Finland, Sweden, and the USA.

To put that in perspective I read an IAEA report from 2000 saying the same thing.

On pg 47 we are told that High level waste at Koeberg is in racks which are designed to hold the HLW for the life of the station plus ten years i.e. 60 (or possibly 40 I am not sure?) plus 10 years = 70 years - so that's 10 000 years of toxicity less 70 so we still need to cover 9 930 years.

The fact that the containers have been designed for an additional ten years over and above the operational period was generous but doesn't quite cover it.

Perhaps this gives an indication of when Eskom feels its responsibilities will have come to an end.

Response 8:

On site storage of high level nuclear waste has been shown to be a safe practice internationally and will continue to be the first option for disposal of high level nuclear waste. Development of geological disposal options or other storage (e.g. development of a surface-based high level disposal site) remains an option.

Should no other disposal site for high level nuclear waste be established within 10 years of the decommissioning of Nuclear-1, Eskom's responsibility for on-site management of the high-level nuclear waste would continue.

Furthermore, please note that radioactive waste management practices envisaged for Nuclear-1 are consistent with the IAEA guidelines for a Radioactive Waste Management Programme for nuclear power stations, from generation to disposal. Nuclear Power Station strives to minimise production of all solid, liquid and gaseous radioactive waste, both in terms of volume and activity content, as required for new reactor designs. This is being done through appropriate processing, conditioning, handling and storage systems. In addition, production of radioactive waste is minimised by applying latest technology and best practices for radiological zoning, provision of active drainage and ventilation, appropriate finishes and handling of solid radioactive waste. Where possible, the Nuclear-1 power station will reuse or recycle materials.

All forms of radioactive wastes are strictly controlled and numerous specialised systems and management practices are in place to prevent uncontrolled contact with these substances. These controls and practices differ for the different forms of radioactive waste. South Africa still has to formally release a strategy for the long-term management of HLW, including spent fuel. Until such time, all spent fuel is stored temporarily either in spent fuel pools (wet storage), or in dry cask storage facilities (dry storage). This allows the shorter-lived isotopes to decay before further handling, a management strategy that is acceptable from a safety perspective. It must be noted however that as per the Department of Energy's Media Statement on Nuclear Procurement Process Update as released on 14 July 2015 strategies are complete to develop an approach for South Africa to deal with Spent Fuel/High Level Waste disposal.

Disposal of radioactive waste at an authorised facility is being done according to an approved disposal concept, defined and developed with due consideration of the nature of the waste to be disposed of and the natural environmental system, collectively referred to as the disposal system. The disposal system developed for this purpose makes provision for the containment of radionuclides until such time that any releases from the waste no longer pose radiological risks to human health and the environment. The safety assessment process used as basis for this purpose considers both intentional (as part of the design criteria) and unintentional (natural or human induced conditions) releases of radionuclides. Unintentional releases include consideration of unintentional human or animal intrusion conditions, which might lead to direct access and external exposure to radiation.

Once released into the environment, radionuclides might migrate through the environmental system along three principle pathways: atmospheric, groundwater and surface water. Due to the physical nature of L&ILW and HLW disposal concepts, migration along the atmospheric pathway is highly unlikely. The principle environmental pathway of concern is thus the groundwater pathway, with the surface water pathway of secondary concern as an extension of the groundwater pathway. Disposal

systems are designed so that releases to groundwater or surface water are highly unlikely as further explained in Chapter 10 of this EIR.

Comment 9:

So the report flounders on:

I quote "The National Radioactive Waste Management Policy and Strategy recognises that the storage of spent fuel is not sustainable indefinitely. Government should thus ensure that investigations are conducted within set timeframes to consider the various options for safe management of spent fuel and high-level radioactive waste in South Africa."

In other words, the author tells us that South Africa will solve a problem that no-one in the world has yet been able to solve and not only that but within a set timeframe.

Response 9:

Kindly refer to the National Radioactive Waste Disposal Institute Act No 53. Part of their functions are to conduct research and develop plans for the long-term management of radioactive waste storage and disposal. This is similar to what countries such as Finland, Sweden and others are doing.

Comment 10:

What the nuclear industry and government has realised, cunningly, that the best way to get rid of these unpleasant problems is to create a highly paid organisation who remove all these issues from the public arena and file it away with useless legislations which are ultimately meaningless because they are created and "enforced" by the same industry that uses them.

So we can sleep easy now knowing we have a National Radioactive Waste Disposal Institute.

We've given this tricky problem to them and they will sort it out.

Response 10:

Far from removing the issue from the public arena, the issue of finding a long-term repository for nuclear waste in South Africa is a process that would need to be conducted in the public domain.

The functions of the National Radioactive Waste Disposal Institute (NRWDI) in terms of Section 5 of the NRWDI Act of 2008 is to “provide information on all aspects of radioactive waste disposal to the public in general, living in the vicinity of radioactive waste disposal facilities”. Furthermore, the functioning of the NRWDI would, like that of all other public institutions, be governed by the Promotion of Administrative Justice Act, 2000 (Act No. 3 of 2000) and the Promotion of Access to Information Act, 2000 (Act No. 2 of 2000).

Furthermore, the establishment of any nuclear waste management facility would be subject to an environmental impact assessment process and a waste management license in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). Both of these application processes require extensive public participation.

Your comment about the legislation being meaningless because it is created and enforced by the same industry that uses it is noted. Would the respondent prefer that the legislation should instead be created and administered by people who are not experts at nuclear science?

ADDITIONAL COMMENTS FROM INDEPENDENT NUCLEAR SPECIALIST

Agreed - and again it must be emphasized that these arrangements are in line with international best practice - however it should also be noted that in appointing member to the board of the NRWDI the minister through the media and by notice in the Gazette, invite nominations of suitable persons from members of the public as candidates for the relevant positions on the board.

Comment 11:

If they are anything like the NNR they will deal with all issues by coming up with new ways to market themselves and Build Public Confidence.

Response 11:

Your comment is noted.

Comment 12:

It would seem that GIBB has not sought to accurately present all data, both positive and negative, in a truly unbiased environmental assessment demonstrating the impact of a new nuclear plant. Instead they have considered as their mandate to seek to mitigate (seemingly against all odds) all concerns and issues with relation to the many negative impacts of this plant.

I would like to state that this EIR is fundamentally flawed in this respect.

References:

Lehnert, B.E., Goodwin, E.H. Cancer Res. (1997), 57, 2164-71.

Wei Han and K. N. Yu Ionizing Radiation, DNA Double Strand Break and Mutation Advances in Genetics Research. Volume 4 City University of Hong Kong, Hong Kong (2010) Nova Science Publishers, Inc.

Oleg V. Belyakov, Heli Mononen and Marjo Perälä; Radiation Effects Studies of Non-Targeted Effects of Ionising Radiation STUK - Radiation and Nuclear Safety Authority, Helsinki, Finland

Response 12:

Your comment is noted. It is to be noted that the EIA process as defined by South African environmental legislation, is by its very nature a project-specific process dealing with a specific technology on defined geographical area and is not designed to deal with strategic issues such as the debate whether or not nuclear technology is safe, in principle, and whether it is an appropriate power supply option for South Africa. The strategic in principle questions of whether nuclear electricity generation should be developed in South Africa is, therefore, not a question that can be answered by the EIA process.

The majority of your comments question the very fundamentals of nuclear science, such as how safe levels of exposure to radiation have been determined. It is not within the mandate of an EIA process to re-evaluate fundamental questions of nuclear science that has been accepted by the vast majority of nuclear scientists across the world.

Yours faithfully

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For GIBB (Pty) Ltd
The Nuclear-1 EIA Team