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CRITIQUE OF NII REPORT ON BRITISH NUCLEAR FUELS MOX FUEL QUALITY CONTROL

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"There are many lessons to learn."

Lawrence Williams, HM Chief Inspector, Nuclear Installations Inspectorate, February 18th 2000.

There is a widespread perception that the UK's Nuclear Installations Inspectorate (NII), report¹ on the falsification of plutonium Mixed Oxide fuel (MOX) at the British Nuclear Fuel's (BNFL) MOX Demonstration Facility (MDF) located at the Sellafield site, was a devastating critique of the company's quality control standards. There are indeed important and critical issues addressed in the report. They have, together with the other reports released on general site safety and the storage of High Active Waste, significantly contributed to the broad media and public understanding, both in the UK and overseas, that BNFL's Sellafield operations are unsafe. However, there are strong reasons to argue that the NII has failed to substantially investigate both the extent and the underlying reasons for the original falsification of MOX Quality Control (QC) data produced by the MDF plant.

Whereas the NII emphasized that it would 'pull no punches', its release of its MOX falsification report has exposed the limited extent of its own investigation. This is a fundamentally important matter. The report makes recommendations for BNFL to implement, the adoption of which will allow restart of MOX production at MDF. However, since the extent of the falsifications, and in particular the underlying reasons as to why they took place, have not been correctly identified in the NII report, implementation of the recommendations will not fundamentally improve operations at the facility.

It is worth mentioning that repeated requests for further clarification and explanations from the NII have been met with a generally poor standard of response. This is despite NII Chief Inspector Williams soliciting

¹ see, "An Investigation into the Falsification of Pellet Diameter Data in the MOX Demonstration Facility at the BNFL Sellafield Site and the Effect of this on the Status of MOX Fuel in Use", UK Nuclear Installations Inspectorate, February 18th 2000. MOX fuel is a mixture of plutonium and uranium oxide. The NII report investigated MOX produced at the BNFL MOX Demonstration Facility, MDF, which began commercial operation for overseas clients in 1994. MOX fuel is intended to utilize plutonium chemically separated from nuclear reactor spent fuel at BNFL's THORP reprocessing plant. The MOX fuel under investigation by NII was produced for the Japanese client, Kansai Electric Power Company, KEPCO. The fuel was produced from Japanese plutonium between January and December 1998. It is worth noting that Kansai Electric MOX amounted to around 4 tons of fuel, but that the MDF plant, has a capacity of 8 tons MOX each year. BNFL should therefore have completed production of MOX fuel for Kansai Electric after six months, not twelve. Production problems are almost certain [ly] to have occurred. The MOX fuel was shipped to Japan between July and October 1999. While the MOX fuel, was in transit to Japan on board the armed nuclear transport vessel Pacific Pintail, it was revealed by the UK newspaper, 'The Independent' on September 14th, that BNFL had falsified MOX Quality Control data for a second batch of MOX fuel then being produced at the MDF for Kansai Electric. For the next three months, both Kansai Electric and BNFL denied that the shipment which arrived in Japan on October 1st was affected by the falsification scandal. (This despite evidence that pointed to the opposite, which formed the basis of a legal injunction by Japanese NGO's Green Action and Mihama-no Kai). The UK's Nuclear Installation's Inspectorate, which has responsibility for nuclear safety at UK nuclear sites, including Sellafield, was tasked with investigating the falsification affair. It is worth highlighting that the NII only became aware of the falsification after BNFL informed them on September 10th, the day that BNFL were contacted by The Independent newspaper after they had been leaked information on falsification of MOX fuel.

comments and requests for more information. Explanations as to the failures of NII to uncover the scale of falsification have not been forthcoming.²

Fortunately, we have been able to access other sources of information in addition to the NII report. In particular, a series of reports by BNFL's Japanese client, Kansai Electric Power Company (KEPCO), together with a report commissioned by the German state of Lower Saxony, as well as continued critical press reports. All have gone further into the background to MOX production at the MDF than the NII. We summarize the key points contained in these reports and compare them with the NII report, which increasingly looks increasingly flawed in methodology, scope and accuracy. The conclusion we draw from this is that the NII was only interested in learning certain 'lessons' from this affair, and that its primary objective was to focus the attention on individual workers. The NII criticizes general management standards to some extent, but at no point does it suggest that there are basic faults with the MOX production itself.

SPECIAL TREATMENT FOR JAPAN

"The report published on 18 February covered only the production of fuel for Japan." HM Inspector Furness, March 14th 2000³.

From the very outset, the NII has misrepresented the actual scope of its investigation into MOX data falsification. Despite acknowledging that falsification began as early as 1996, (in fact it began as early as 1994/1995, see below), the NII provides no details on the production of MOX fuel during 1996 and 1997 when it was producing MOX for German and Swiss clients. Instead the NII investigation concentrates exclusively on MOX produced in the MDF for Japan. It has subsequently emerged that falsification of both Swiss and German fuel also occurred during this period. Despite identifying the falsification of MOX fuel produced for Germany in 1996, the NII provides no details. Yet upon release of the report the NII does not make it clear that its investigation was limited to Japanese fuel. The extent of the falsification and failure of QC at the MDF, as well as the implications that has for reactor safety, were specifically not investigated by the NII. This failure is now apparent in the disclosure that not just pellet diameter data was falsified, but that fuel data certificates were passed, despite the fuel having failed QC checks. So far this has been confirmed for enrichment and nitrogen QC for MOX fuel produced for MDF's largest client, the Swiss utility NOK. There remains no indication that the NII intends to investigate the production and falsification of plutonium fuel for German and Swiss clients.⁴

The failure to address the production of fuel for other clients, which in fact have had far more MOX fuel produced by BNFL than for Japan, confirms the limited nature of the NII report, and points to a 'special case' being made for Japan. The NII has admitted that in fact it did not discover the extent of falsification in relation to the German fuel, but has considered a report by BNFL into what went into the Lot (industry

² Requests made by Greenpeace and Green Action, Japan, for the quality assurance data received the following response, "We are unable to release the full quality assurance data we hold for lots of MOX fuel made at Sellafield because information was provided to us under the powers given to our Inspectors in Section 20 of the Health and Safety at Work Act 1974 (HWSA). Information acquired by inspectors can only be released: a. for the purpose of an inspectors functions (HWSA) s.28(7)(a) - this is not the case here.(b) With the consent of the person who furnished the information (HWSA s.28(7)(c) - such consent has not been granted, or, (c) For the purposes of legal proceedings (HWSA s.28(7)(b) - there are no such proceedings here. As none of these conditions are satisfied, we cannot release this information. This is also a refusal under Exemption 15 of the Code of Practice on Access to Government Information, information whose disclosure is prohibited under statute." Director's Office, G. Holder, Nuclear Safety Directorate, to P. Roche, Greenpeace UK, March 29th 2000.

³ See, HM Inspector Furness to M. Forwood, CORE, March 14th 2000.

⁴ See, Report on the Safety of NNP Unterweser, Incidents at BNFL in connection with the production of MOX fuel assemblies, TUEV, March 28 2000, report to the Lower Saxony Environment Ministry. The TUEV is the Technical Supervision Association contracted by Lower Saxony to assure fuel standards at Sellafield for use in Germany. It has had this role since 1994. Again in confirmation of the limited scope and special treatment given Japan by the NII investigation, the BMU (Federal Ministry of Environment) to the NMU (Environment Ministry of Lower Saxony), March 9, 2000 states that "With fax of February 22, 2000 the Federal Environment Ministry contacted the British regulator HSE and asked them whether the Mox fuel produced in 1996 (would) fulfill without a doubt the conditions for a safe operation of the nuclear power plant Unterweser. In their answer from February 29, 2000 HSE pointed out that it was the task of BNFL and their customers to prove the safety of the fuel; the NII had not specially analyzed the quality assurance (QA) data of the German fuel."

term for a batch of 3-4000 MOX pellets)⁵ concerned.⁶ In a statement at complete variance with its claim to have conducted a thorough investigation, the NII reports that,

“The Inspectorate has spent sufficient time to establish what has gone on, and having alerted both Swiss and German regulators as early as last September, has made it clear that it leaves it to them to carry out what further investigations they feel are appropriate. I hope that you would agree that having produced a detailed public domain report, it is important for the Inspectorate’s staff to return to their normal jobs of regulating nuclear safety at the Sellafield site.”⁷

The NII acknowledges that there are other cases of falsification, and admits to not knowing of those so far revealed until disclosed by the media, and leaves it German and Swiss regulators to carry out further investigations, if they so wish. In fact the NII has recently restated that,

“Fuel performance is essentially a commercial matter between BNFL and its customers...”⁸

The visit of NII Chief Inspector, Lawrence Williams, to Japan in early March ‘to explain the NII findings’ to Japanese officials underscores the extent to which the NII was prepared to go to assure important Japanese clients about the safety of BNFL fabricated MOX fuel. We suggest that this is due to economic considerations given the importance of BNFL securing Japanese clients for the Sellafield MOX Plant, SMP. In fact the NII visit to Japan goes beyond the statutory remit of the NII to investigate safety at UK nuclear facilities.⁹

STATISTICAL FAILURE

The NII states that its investigation into data falsification “centred mainly on the statistical analysis report.”¹⁰ This however follows the NII admitting in the prior paragraph that their own statistical analysis had failed to identify pellet diameter falsification of Lot P814 (MOX pellets fabricated in the fuel delivered to Takahama-4 power plant, first referred to as suspicious but not falsified). It explains the reason for this deficiency being “... the protocol adopted for HSE’s analysis would not have identified this method of falsification which was to copy a large section of one spreadsheet to a different location in the other.”¹¹ It then immerses itself in contradictions and self-deception when it states, “The existence of Lot P814 does not invalidate the analysis or conclusions of HSE’s statistical work.” Why not ?

The statistical analysis selected by the NII was recommended by the Health and Safety Executives (HSE’s) Epidemiology and Medical Statistics Unit (EMSU). However the types, range and motives of the falsification conducted by BNFL requires the expertise of forensic statisticians, who are trained to examine data that has been deliberately falsified. The NII recognized that its analysis would not be exhaustive, and that other methods of falsification could have been used, but that it calls on BNFL to investigate these, and yet concludes that it has investigated sufficiently the extent of falsification. Given the admission by NII that their investigation was based upon their statistical analysis and that it failed to detect a rather crude and simple falsification, the credibility of their investigation and its conclusions is further undermined. In fact the NII has only been able to identify a fraction of the falsification that occurred during the lifetime operation of the MDF. For example Kansai Electric in its March 1st report points out that the random sampling inspection distributions for several lots of Takahama Unit 3 and 4 fuel did not match the distributions of the total pellet selection. Kansai Electric chose 16 lots which had especially large differences in distribution size and found that there were three types of non matching distributions. They classify these lots as:

⁵ There are for example there were 204 lots of MOX fuel produced for Takahama-4, amounting to around 700,000 MOX pellets.

⁶ (opcit, Furness to CORE, March 14th).

⁷ ibid.

⁸ see, Nuclear Safety Directorate, G. Holder, Director's Office to P. Roche, Greenpeace UK, March 29th 2000.

⁹ In fact, the Nuclear Installations Act, under which the NII issues licenses for nuclear sites in the UK, states that the NII covers “occurrences involving nuclear matter” (and damage from these) only when the nuclear matter is on the licensed site, being transported by the company with the license, or is somewhere off-site that is not licensed. It does not cover anything that has been shifted to another licensed site or is already in another country. Therefore the conduct of the NII in relation to the German and Swiss MOX fuel, at least in terms of deeming it safe or not to use, is consistent with the Nuclear Installations Act, whereas its assurances to Japan are not.

¹⁰ Item 44, NII report, opcit.

¹¹ Item 43, ibid.

- (a) lots where the distribution shapes are on whole very different;
- (b) lots where the random sampling inspection data values are wider than the total pellet selection data;
- (c) lots where there are peaks in the random sampling distribution that are not found in the total pellet selection distribution.

The findings by Kansai Electric highlight the range of pellet diameter falsification and manipulation that took place at the MDF. Kansai refer to the fact that when pellets were selected and were out of specification, they were revolved through 90 degrees so as to find the right specification. Checks were clearly not random in their selection. Passing fuel that should have failed has not been acknowledged by the NII investigation.

In response to a letter sent by Green Action and Greenpeace on January 13th 2000, the NII states that it “*did make an analysis of all 392 lots of fuel bound for Takahama.*” However, the NII report makes no mention of the 16 lots selected by Kansai Electric. We have submitted further questions to the NII seeking clarification of this issue (see Appendix 1).

QUALITY OF FUEL: NOT IN NII'S REMIT OR COMPETENCE ?

*“We were not aware of problems with Swiss fuel before The Independent article of December 23rd.”
Nuclear Safety Directorate, March 29th 2000.¹²*

The NII while reaching broad and unsubstantiated statistical conclusions about fuel safety then uses its statutory limitations to abrogate itself from the responsibility of fully investigating the causes or motivation for the falsification. This relates to the specification for the fuel, which the NII states is a matter between BNFL and their customers. Without an understanding of the specifications set by the customer, the NII has missed a vital factor in understanding a key element in this affair. Put simply, BNFL from the beginning of commercial operations at the MDF could not, and cannot produce MOX pellets to the original specifications proposed by their customers.

In the case of MOX fuel produced for German utility Preussen Electra Kerkraft, the TUEV report states that the very tight diameter tolerance specified by Siemens of +/- 10 micrometer caused a high rejection rate in the MDF. Rather than rejecting BNFL as a supplier for its MOX fuel, Siemens raised the tolerance to +/- 13 micrometers. This was discussed as far back as 1994, again NII provide no details of this in their investigation. Failure to be able to deliver fuel to specification should be seen as a fundamental motive for the subsequent poor application of Quality Control standards by BNFL, and of course, falsification.

Siemens learnt that BNFL could not produce MOX pellets to specification. This was not investigated by NII, but remains one of the principal reasons why consistently poor QC standards and falsification and manipulation of data occurred. This is clearly not the responsibility of individual workers but rather a fundamental failure of BNFL MOX technology.

NII states that it has high confidence in the automated 100% check on all pellet diameters coupled with other checks during manufacturing in coming to the view that the fuel will be safe to use. This is an issue of extreme importance, and further exposes the NII to the charge that it has actively collaborated with BNFL to deceive and misrepresent the purpose, effectiveness and reliability of the all pellet diameter measurement.

Before the NII moves off the first page of its report it makes the mistake of stating that the “fully automated laser micrometer (which) checks and records the pellet’s diameter at three points along its length gives a 100% automatic check on all pellets used in a fuel rod.” In fact BNFL has recently admitted that the fully automated laser micrometer measurements were deliberately applied not along the pellets length (13mm) but rather all three measurements were taken within a narrow 2mm width above and below the center of the pellet.¹³ In other words, BNFL deliberately lowered its measuring standard to allow pellet production to proceed, rather than confront the problem that the technology used in the MDF, based upon the Short-Binderless Route (SBR), could not produce to standard. Taking a lesson from the NII we think it is worth noting that the new, yet to-be opened, Sellafield Mox Plant (SMP), relies upon the same technology used in

¹² opcit, Holder to Roche, March 29th 2000.

¹³ See, The Independent, 'BNFL Deliberately lowered safety standard to boost output', March 7th 2000).

the MDF. Kansai Electric has confirmed that the altering of the measurements was agreed between BNFL and its customers in 1995, thereby confirming that Swiss and German fuel are affected.¹⁴

No details have been revealed as to who made the decision to alter the method for measuring the pellets. But given that it dates back to 1995, it was clearly an essential factor in permitting BNFL to produce MOX over the past 5 years. Such a decision could only have been made by MDF management, not process workers, who up to now have been held solely responsible for falsification. The NII, upon disclosure of the BNFL measuring technique, admitted that it had been unaware of the changes made by BNFL during the automated all pellet diameter measuring - or *"why BNFL should have made any changes."*¹⁵ An investigation, described by the NII as 'thorough' that does not identify this central issue should raise questions as to NII's competence and what it actually was investigating. That the NII is unable to explain why BNFL would do such a thing is incredible.

Lawrence Williams in testimony to the UK Parliament's Trade and Industry Select Committee on March 7th 2000, insisted that that the change in diameter readings did not affect the safety of the fuel. This comment was made on the day of disclosure of the changed measurement procedures, and certainly before Williams or anyone else at the NII had time to consider the fuel safety implications. It wholly illogical reasoning by the Chief Inspector, given his assurance that the falsified MOX fuel produced for Japan was safe because of the *"robustness of the automated check"*.

The inability of the NII to understand the implications of the revelation that BNFL deliberately lowered its safety standards for the conclusion and recommendations of its investigation is quite staggering. In fact, rather than considering the implications, the NII rushed to reassure that the fuel was still safe, solely based assurances by BNFL that the pellet diameters produced were highly consistent, and there was therefore no need to take readings at both ends.

Evidence that BNFL passed MOX pellets that in fact were substandard and outside specification was already available to the NII as early as September last year, if it had taken the trouble to look. This evidence would have indicated that fuel that should have failed was actually passed by BNFL. However, two Japanese groups, Green Action and Mihama-no-Kai, did investigate, though they did not, and still do not have access to the extensive BNFL data that NII is privy to. However, they were able to base part of their legal injunction against the loading of BNFL produced MOX by Kansai Electric on the charge that BNFL had deliberately manipulated data to pass fuel that should have been rejected. BNFL admitted falsification two days prior to the court decision on the case. Despite repeated questions to NII on this matter, it has failed to provide any explanation.

The conclusion is the NII is seeking to have its cake and eat it too. It claims to have conducted a thorough investigation, but when challenged on its failures it defers to the BNFL/customer relationship. Nothing could demonstrate this fact more than recent correspondence to Greenpeace when the Nuclear Safety Director's office in answer to a question as to why there were discrepancies between random QC and all-pellet measurement, states,

*"Because the "random" inspection is by nature a diverse check on pellet diameter (sic), there are a number of reasons why it may not produce the same result in terms of pass or fail as the automated "failsafe" diameter measurement process. The various stages in the production process, and the conditions for repeating measurements if this proves necessary, have all been agreed between BNFL and its customers. They are not a matter for us."*¹⁶

DELIBERATE MISREPRESENTATION OF THE AUTOMATIC PELLETS MEASUREMENT

"The NII concluded that data had indeed been falsified but that this would not affect the safety performance of the fuel, given the automated primary diameter check on 100% of the pellets used in each rod."

¹⁴ Kansai Electric to Aileen Mioko Smith/Green Action, March 2000.

¹⁵ Nuclear Safety Inspector was Kept in Dark by BNFL, The Independent, March 8th 2000.)

¹⁶ opcit, Holder to Roche, March 29th 2000.

There is considerable evidence to state that the NII throughout its report has misrepresented the purpose and effectiveness of the Automatic Inspection System, and de-emphasize the importance of the actual Quality Control checks. In what can only be described as collusion with BNFL, the NII through its position of authority has actually reinforced and endorsed one of the fundamental reasons why falsification was able to be carried out. Workers conducting QC at MDF were encouraged by BNFL to view their job as not essential, due to the so-called effectiveness of the all pellet measurement in removing pellets that were beyond specification. This fact is not detailed in the NII report, but is in the Kansai report (see below).

The NII states that “there is a robust case for saying that the 100% primary diameter check alone will provide adequate confidence that all pellets are within specification.” They describe this “check” as “failsafe by design”, and that with the application of a control gate, “out of specification or unmeasured pellets are thereby guaranteed to be ejected from the process stream”. They then describe the Quality Control check, as simply “a secondary sample check for diameter (known as over-inspection).” It is worth noting that in NII’s latest correspondence to Greenpeace they refer to the all-pellet measurement as a “process” rather than “check”.¹⁷

While the problems with the inspection random sampling operating manual used in the MDF is excluded from the NII report. However, Kansai Electric in its interim report released publicly on March 1st does highlight it. Kansai Electric states, “*In the inspection instruction manual, the automatic total pellet selection was referred to as “the total pellet inspection,” and the random sampling inspection was referred to as an “additional inspection.”*” The NII refers to the same inspection as a “secondary sample check,” or “over-inspection.”

Unlike the NII, Kansai Electric concludes that this use of language in the operation manual “*would bring about misunderstanding*”.¹⁸ On April 7th, Kansai Electric restated that the use of the term over-inspection in the operating manual and the NII report was “*unfortunate*”.¹⁹

In addition to Kansai Electric, both Siemens and the TUEV, in its March 28th report to the government of Lower Saxony, state that the automatic checks are not part of quality control, but of production. They understand that the total “checks” are not part of the specification process and “*proof that pellets are within specification can only be made through the QC check, not the automatic check*”.²⁰ This is completely at variance with the assessment made by NII.

The NII should be aware of the difference and significance of the two diameter checks. Instead, they have opted, along with BNFL, to deliberately misrepresent the automatic pellet diameter measurement as quality control, allowing them to conclude that the fuel is safe due to the all pellet measurement. In the case of BNFL, it was QC workers who were encouraged via the BNFL instruction manual to view their job as almost redundant due to the “*all-pellet inspection*”, with the NII it was the reader of their investigation, which of course included BNFL’s Japanese clients and UK and Japanese government civil servants.

All of this points to a conspiracy to deceive. The motive for BNFL should be obvious, to allow them to produce MOX fuel that they actually were incapable of producing to standard, and when there were problems, to be able to convince workers that they were not actually doing anything that would risk passing unsafe fuel. The motive of the NII also appears clear, they do not wish to extend this crisis to the question of whether BNFL can produce MOX to a high standard as this would further undermine the case for authorize the Sellafield MOX Plant. A decision by the government on the opening of the MOX plant has been pending since construction was completed in June 1997. We have asked for further clarification of these issues in questions to the NII, see Appendix 1. It does further raise the question as to whether the NII is competent and independent enough to conduct the required investigation of BNFL MOX production.

It was confirmed by UK Minister of Energy Helen Liddell on April 5th that BNFL has made a translation of the Kansai Electric report, “*for their own internal use*”, and that a “*copy of that English language text has been passed to officials in my Department*”.²¹ On the basis that the BNFL translation contains the same details as the original Kansai Electric report, the UK Department of Trade and Industry, including the NII, should now be

¹⁷ *ibid.*

¹⁸ see, p.21 of An investigation into the problem of BNFL fabricated MOX fuel, Kansai Electric Report March 1st 2000, in Japanese, English translation by Stephen Ready, Green Action.

¹⁹ see, correspondence between Green Action and KEPCO, April 7th 2000.

²⁰ *opcit*, TUEV to Lower Saxony, March 28th 2000.

²¹ see, Hansard, Liddell to D. Chaytor, 5 April 2000.

learning something that if they had conducted a thorough investigation in the first place they would already know. Public disclosure of this document in the UK (and comparison with Japanese original) should be immediate.

In an examination by Green Action of the total pellet measurement data released by BNFL to Kansai Electric, it was found that there was a significant range of measurements for the all-pellet data. In the case of Lot 848 produced for Takahama-4 reactor, there are examples of differences as much as 10 microns between the two outer measurements. Given that it was confirmed post-release of the NII report, that BNFL took all three measurements within 2mm of the center of the pellet, there is no way of knowing what the actual diameter measurement of the pellet is. NII's statement that "*any pellet containing one or more out of specification results is automatically rejected by a gate mechanism*" is thus irrelevant as BNFL were not making the measurements as described by the NII, and therefore pellets of dimensions out of specification could, and did, pass the gate control mechanism. Thus, the NII statement that "*out of specification or unmeasured pellets are thereby guaranteed to be ejected from the process stream*" is incorrect. Despite repeated questions to the NII, they have refused to acknowledge to us that seven lots (amounting to between 21-28,000 MOX pellets) cleared the all-pellet diameter measurement, including the control gate, but then failed the random QC sampling inspection.

The NII cite the specification range for pellets for Kansai Electric as plus or minus 0.0125mm, restating BNFL's claim that the automatically measured diameter is accurate to within plus or minus 0.002mm. Again this is an irrelevant point, given the invalid method used by BNFL to measure the pellets. In fact analysis of some of the total pellet measurement data reveals that even with the three measurements taken within a 2mm central belt of the pellet, BNFL had a wide range of pellet diameters, including on the margins of the specification agreed with Kansai. What the actual measurements would have been had they been measured as originally designated nobody knows. Moreover, the random QC sample is only for 200 pellets out of each Lot.

The fact that seven lots of pellets did fail a random sampling quality control inspection, though NII refuse to acknowledge this, leads us to the following conclusion: out of specification pellets are not guaranteed to be ejected from the process stream. This could have potentially serious consequences for reactor safety.

INVALID ASSURANCE ON FUEL SAFETY

The NII has gone out of its way, and beyond its statutory duty, to assure Kansai Electric, the Japanese Ministry of Trade and Industry (MITI) and the people of Japan, that the MOX fuel delivered to Takahama-unit-4 is safe to use. The basis of their assurance is an assessment made by BNFL, examined by NII "*fuel specialists*".²² After briefly assuring that all checks conducted for density, homogeneity, etc. are in line with specification, (again without sufficient substantiation) it focuses most of its attention on pellet diameter, where it has concentrated its investigation. One point it highlights is the importance of the accuracy of measurement and the confidence in the "*pellets diameter (is) important because if the pellet is too large it will not fit the cladding tube. If it is too small it may move around and possibly cause cladding collapse: cracking of the clad gives rise to fission product release.*"²³ It then states that, "*BNFL recognizes the importance of this and provides several quality control checks on the process.*"

The NII then asks,

"The key questions are how much reliance can be placed on the 100% automatic measurement of pellet diameter and failsafe system for rejecting pellets which are out of specification..."

To answer this again the NII relies on BNFL assessment, citing the "overall conclusion by BNFL was that the accuracy of the 100% automatic check...was such that the absence of the AQL (Acceptance Quality

²² The UK Department of Trade and Industry (DTI), interestingly seems to accept the NII line, having stated on March 30th that it still believes the pragmatic option is to keep the fuel in Japan, and that after further safety checks it could still be used in the reactor (in Japan), Kyodo, March 30th 2000.

²³ See item 83.

Level) check would not impact on the ability of the fuel to perform safely in reactor operation.” This leads the NII to conclude that,

“There is a robust case for saying that the 100% primary diameter check alone will provide adequate confidence that all pellets are within specification.”²⁴

As we have seen, and learnt from Kansai Electric, not the NII, BNFL’s all pellet “check” is not reliable, nor is it a check. Both Siemens and TUEV agree, and have restated the importance of the QC, rather than the total pellet measurement which is part of the production process not quality control. Given that the NII stress the importance of this measurement for assuring the safety of the fuel, it is extremely disturbing that the NII was unaware that BNFL in fact significantly altered the way all-pellet measurement is conducted. They conclude,

“The NII is satisfied that the fuel manufactured in MDF will be safe in use in spite of incomplete QA records caused by the falsification of some AQL data by process workers in the facility. The NII takes this view on the basis of the robustness of the fuel manufacturing process and the totality of the checks made on the key parameters.”²⁵

“Firstly in relation to the physical properties of the SBR-MOX fuel pellets, the MOX demonstration programme coupled with BNFL’s extensive expertise in oxide fuel manufacture and NII’s examination of the plant and processes carried out in the MDF fuel pellet production area are such that NII is confident that the MOX fuel pellets produced in MDF are of the required quality and will perform as designed in the reactor.”²⁶

They conclude,

“Finally NII is satisfied that the 100% automatic check on fuel pellet diameter is sufficiently robust to ensure that only fuel pellets which will not prejudice the safety of fuel pins in operation are used in fuel rod assembly.”²⁷

Our conclusion is that the basis of NII’s assurance on the safety of the MOX fuel produced for Kansai Electric, and any other MOX fuel produced in the MDF is fundamentally flawed. It raises further serious questions as to the competence and independence of the NII in assuring nuclear safety.

BNFL’S PRODUCTION PROCESS - THE ROOT OF THE PROBLEM

“...BNFL stated that due to the performance of the grinder at MDF, there was no regularity to the diameter distribution and that random sampling inspection by variables could not be applied.” Kansai Electric Report, March 1st.

“(In December 1994) ... TUEV criticized (BNFL) that quality control and production were not sufficiently independent of each other.” Report to Lower Saxony Ministry of Environment, March 28 2000.

The NII set as one of its central objectives the determination of the reasons falsification took place at MDF. However the NII then proceeded to only look at one relatively late stage in the MOX production process, specifically the Quality Control stage. All stages prior to this, from the mixing of the plutonium and uranium oxide powders, to the application of the all-pellet diameter measurements, relied upon the information and assurances given to it by BNFL. There is enough information now in the public domain to determine that this is one of the primary reasons the NII investigation has failed to uncover the underlying motives for falsification at BNFL. As more information enters the public realm, the underlying reason for falsification becomes clearer. The production process itself is at fault.

There are important issues along these lines which have been raised in the reports of BNFL customers and overseas inspection agencies, that NII has chosen to ignore. Perhaps most remarkable is that more than five

²⁴ See item 84.

²⁵ Item 89.

²⁶ Item 90.

²⁷ Item 92.

year ago, in December 1994, problems were identified at the plant by non-UK agencies, and yet the NII has still to provide details on this. This despite the greater access the NII has had to BNFL, the site and workers, and management over the last six months, even though it was charged specifically with the objective of identifying the cause of falsification. More details on the problems with MOX production technology, including rheology (the technology of powders) are included in a recently released report.²⁸

As we have learnt from other sources, BNFL MOX pellet production technology, including the grinder, is incapable of making pellets that are consistently of a cylindrical diameter. In 1995 Mitsubishi Heavy Industries conducted an inspection at the MDF. During that investigation they noticed that BNFL had not automated the random QC sampling measurement. BNFL cited that there was plutonium contamination that prevented the automation (this would have meant installing cabling through the glove boxes) and the automation was not done. Following on from this, Mitsubishi identified a significant problem in BNFL's inability to produce pellets within a narrow range of diameter. Specifically, Kansai reports states,

*"It was also confirmed that the ability to manufacture pellets with a small variation in diameter was not sufficient."*²⁹

Mitsubishi reported this to Kansai Electric at the time, but they took no further action.

Further confirmation of the pellet diameter problem is given by the German Inspection Association, TUEV in its recently completed report into BNFL MOX production, prompted by the falsification scandal involving Kansai Electric. TUEV were requested to investigate after the disclosure that MOX fuel supplied to Germany contained falsified QC data (the reactor concerned Unterweser was closed down in February to remove the BNFL MOX fuel affected). Its report is currently being examined by the Lower Saxony government. Every year since 1994 the TUEV, together with Siemens, has noticed defects in the quality assurance management system operating at MDF. TUEV criticized BNFL that quality control and production were not sufficiently independent of each other. Only after fuel production had begun for the German reactor, Unterweser, in 1996, was TUEV informed that changes had been made, though falsification was to later occur.

Significantly, TUEV had earlier been informed that the application of a "strict diameter tolerance of +/- 10 micrometers caused a high rejection rate."³⁰ In other words, a strict standard was too difficult for BNFL to meet. TUEV agreed to a lowering of standard by a full 30% to +/- 13 micrometers. When TUEV received the final data on the fuel, which we estimate was in late 1997 when the fuel was delivered to Germany, they criticized nine deficiencies, including three diameter documentation data, (though they have yet to explain what precisely they found). TUEV appears to have failed to take this investigation further, nor did it notice that pellet density data had been copied on two lots of MOX fuel.³¹ Thus as early as 1997 problems in the QC data, were detected, not by NII, but by a German inspection agency. Having said this, both Siemens the fuel contractor with BNFL on behalf of German utility PreussenElectra, for MOX produced for Unterweser NPP, and the TUEV, do not escape criticism. A large question remains to be answered as to the commitment of Siemens to high fuel standards and why it permitted these problems to persist over the last five years. Unbelievably, the TUEV did not visit Sellafield until February 2000 to take up investigations, this despite knowing as far back as 1997 that there were problems with the QC data.

SELLAFIELD MOX PLANT: FLAWED BEFORE IT EVEN OPERATES

"BNFL's process, which has been proven successfully during the life of MDF, has been employed in SMP." John Taylor, Chief Executive of BNFL, February 18th 2000.

²⁸ see, Fundamental Inadequacies in the Quality Control of Mixed Oxide Fuels, Dr F. Barnaby/S. Burnie, Greenpeace International, Fukushima Coty, Japan, March 27th, 2000.

²⁹ opcit, Kansai Electric report, March 1st, "Qualification Inspection for MDF, 3.4.2."

³⁰ opcit. TUEV, p.38.

³¹ It is worth noting that BNFL in its report on the MOX falsification issue, claim that "the data obtained on the key quality characteristics during the fabrication of several tons of MOX fuel pellets" in its MDF plant shows that, "No difficulties have been experienced controlling the pellet dimensions, the density..." And yet they have falsified density data. NII's acceptance without apparent questioning BNFL assurances on the quality of the MOX product is exposed once again as flawed.

Throughout the last five years, BNFL has promoted its MOX technology as superior to its rival producers, Cogema and Belgonucleaire. Specifically the Short Binderless Route (SBR) developed and used in the MDF, has been incorporated in the yet to be opened Sellafield MOX Plant (SMP).³²

Problems with the technology in the MOX Demonstration plant have been acknowledged by BNFL. At the same time, in recent weeks it has been revealed that the pellets produced by the SBR method has led to pellets that are not shaped correctly. Our analysis of the TUEV report suggests that the pellets may in fact not be 'flowerpot shaped' as reported by The Independent newspaper on March 7th, but rather more 'hourglass', with both ends having different dimensions from the central point in the pellet. It is the central 2mm belt that BNFL take their all-pellet measurement. This may be one reason why pellets measured in the all-pellet stage, subsequently failed the random sampling QC stage. Automated measurement, as noted by Siemens and TUEV, is therefore no guarantee of either the reliability of production or the accuracy of measurement. It is not a QC check.

However, the NII, either ignorant or choosing to ignore the failure of all-pellet automated measurement noted above, states, "*one point worth noting is that in the new Sellafield MOX Plant, currently being commissioned, the inspection processes for MOX pellets, rods and assemblies are designed to be almost fully automated: this should prevent the falsification of data of the kind described in this report.*"

BNFL have even stated that,

*"The optimized SBR process (in SMP) reduces the number of quality control samples required and results in a larger quantity of fuel with uniform Pu isotopic composition."*³³

Along with BNFL, NII claim that because SMP is an automated plant the quality control of the MOX pellets will be much superior to that in the MDF plant. Rather the situation is that in the SMP plant three of the 15 pellet checks in the BNFL quality control list will be automated - the diameter check, a check of the circumference, and inspection of the ends of the pellets. The last two checks look for damage to the surface of the ceramic pellet - chips, and so on. The other 12 checks will be carried out by taking samples in a way similar to that at MDF.

Since the specification of pellet quality will likely be the same for SMP and MDF pellets, as it is the same SBR technology, the frequency with which the 12 non-automated checks are performed will be similar. The concerns about the inadequacy of important quality control checks (particularly checks for inhomogeneity) of MDF MOX pellets will therefore apply equally to SMP MOX pellets. The BNFL and NII claim that the quality control of SMP MOX pellets will be superior to the quality control of MDF MOX pellets, just because the plant is automated cannot be substantiated.

Not only are BNFL and the NII mistaken in their claims, the question should be asked why the NII thinks it is necessary to make this point? The only conclusion we can reach is that it is because the NII wishes or has been instructed to actively encourage potential clients of the new plant to believe that BNFL can be relied upon to produce MOX fuel to an acceptable standard of quality. It is worth noting that BNFL has so far only secured contracts amounting to 6.7% of the production capacity of the SMP over a ten-year operating lifetime. Customer confidence in MOX production and QC standards at Sellafield having been shattered, it is now vital for BNFL to seek to make a distinction between the MDF and the SMP. BNFL's action plan as laid out in its own report, coincidentally released on the same date as the original NII report, refers to the need to restore customer confidence which includes inviting its customers "*to consider participation in an SMP Task Force to ensure that all of these activities are properly coordinated and aligned with customer's requirements.*"³⁴ It is not clear as to whether Kansai Electric, along with other utilities, have taken up BNFL's offer.

The proper role of the NII is to apply strict regulations to ensure safety of nuclear sites in the UK. In view of its recent finding that safety levels at Sellafield are "only just tolerable", it has clearly failed in this task.

³² for more details on the technology including comparative analysis with the Cogema/BN MIMAS process see, Fundamental Deficiencies in MOX Quality Control...(opcit.)

³³ Bairiot, H., van Vliet, J., Chiarelli, G., Edwards, J., Nagai, Sh., and Reshetnikov, F., 'Overview on MOX fuel fabrication achievements', International Symposium on MOX fuel cycle technologies for medium and long term deployment: experience, advances, trends', International Atomic Energy Agency, Vienna, 17-21 May 1999.

³⁴ (see, BNFL MDF Report, February 18th 2000).

At the same time it is actively promoting the benefits of the SMP, seeking to make a distinction between the standards of QC applied at the SMP from the discredited MDF. The NII is not supposed to be a promotional arm of BNFL's discredited MOX business.

NII RECOMMENDATIONS: IRRELEVANT TO BNFL MOX PRODUCTION STANDARDS

As we have sought to demonstrate, the NII has conducted an inadequate and flawed investigation into MOX QC data at the Sellafield MOX Demonstration Facility. It has also repeatedly stated that the MOX fuel remains safe with no implications for reactor safety. Again, this has been based upon limited information and poor intelligence gathering, leading to invalid conclusions being drawn.

Having completed its investigation, the NII presented to BNFL a series of requirements. The NII would only consent to the restart of MOX production at the MDF when these 'significant improvements' have been made. However, specific changes that relate to QC and operational aspects of the plant are almost entirely missing. The NII having ignored the fundamental issues of plant production technology, the reliability of the machine tools, including grinders, the inherent problems that exist with powder technologies. It is no surprise that they make no recommendations that will improve BNFL's fundamentally poor production standards. The physical changes they recommend relate to automating the random pellet sampling QC measurements, so that data is directly imported into the computer. This will make no difference to BNFL's inability to produce consistently shaped and sized MOX pellets. It is worth noting that QC control standards including the automated random sampling technology, used by Cogema at its Cadarache MOX plant, is currently under investigation by three German state regulators and Siemens, following 'false data' being retained in the computer following a 'software error'.

With the "automation" of the random sampling QC stage, BNFL will have automated 1 of the 15 QC checks required. Even this so-called automation will require human intervention, probably via a foot pedal, to allow the automatically measured data to enter the computer. All others require manual entry of data. The same is true of the Sellafield MOX Plant. While pellet measurement QC is an important factor in terms of fuel safety, so are many of the other QC checks, in particular enrichment and homogeneity. The failure of the NII to address these issues, and instead to rely upon BNFL data and assurances, highlights the poor regulatory oversight in matters related to nuclear fuel standards. As a recent study has concluded that the frequency of all BNFL QC checks (as well as Belgonucleaire and likely Cogema), with the exception of diameter, is so low as to be statistically unreliable.³⁵ As has been revealed in recent weeks, but not by the NII, BNFL has for the past five years deliberately altered the method of conducting its all pellet diameter measurement. This was to permit pellets that would have been rejected to pass the control gate to the QC stage. The problem according to BNFL does not exist after the pellet has been ground. But BNFL has already confirmed to Kansai Electric that their grinder was not able to produce a regular diameter to the pellets. Again, no reference is made to this in the NII report.

Our conclusion is that the NII recommendations, while important in terms of management changes, fail to address underlying issues of production standards and therefore the motives for falsification which existed over the last 5 years remain. Specifically, BNFL could not produce MOX fuel to specification. This was known as far back as MDF commercial start-up in 1994. Nothing in the recommendations made by NII will change this reality. Falsification has been designated a symptom of poor training, tedium and management failure. In fact, adjusting the production measurements and checks to allowed out of specification pellets to pass them was a necessary condition to enable BNFL to produce MOX fuel over the past 5 years for its customers. Such "adjustments" included changing the specification, altering the position of laser measurements on the pellets and allowing the deliberate rotating of pellets to pass them through a manual QC test that they otherwise would have failed. Falsification took place in a context where passing pellets that would have originally failed the specifications was de-facto deliberate management sanctioned practice.

It should perhaps come as no surprise that the real reasons behind falsification have yet to be widely acknowledged by the British government, including the NII. BNFL's MOX business is actively promoted by the UK Department of Trade and Industry (DTI). At the same time, the NII through the Health and

³⁵ Opcit, "Fundamental Deficiencies in the Quality Control of Mixed Oxide Fuel".

Safety Executive, operates out of the same DTI. It is this indirect relationship that perhaps goes some way to explain the conclusion reached by the NII following its limited investigation:

“It has not been possible to identify the motive for this falsification...” Lawrence Williams, Chief Inspector NII, February 18th.

For the NII to have done so would have ended all prospects of BNFL producing MOX again, either in the MDF or the SMP. Some things are just too sensitive.

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