STATEMENT ON THREE ISSUES PERTAINING TO ENVIRONMENTAL MONITORING AT THE ERA RANGER URANIUM MINE, JABIRU, N.T.

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1. Gulungul Creek and Tailings Dam South Road Culvert

1.1 Geography, Site Designations and Monitoring Programme Design Features

Refer to the general plan view of the RUM mine site, given as Figure 1.1, and the sketch of the tailings dam wall at the point of interest, given as Figure 1.2.

Around the southern side of the dam is a perimeter drain that collects surface water running off the toe, or base, of the outside of the dam and from its surrounds during wet season rain events. Water builds up in the drain and overflows, through a pipe under the road, into a small pond. The pond was then approximately four metres across and up to one metre deep. The pond is designated as Tailings Dam South Road Culvert, TDSRC.

When the pond is full, it overflows down-grade in a southerly direction, passing under the perimeter fence and feeding an ephemeral creek that is tributary to Gulungul Creek. The effluent flow between the pond and the catchment area of the Gulungul Creek tributary is designated as TDSRCX, where X is given in metres as the distance below the pond at which the sample was taken.

The tributary conflues with Gulungul Creek south west of the mine side and the latter flows in a northerly direction until it intersects the Arnhem Highway about one kilometre west of the Jabiru Airport. The intersection in designated as Gulungul Creek Highway, GCH. Gulungul Creek continues northward and conflues with Magela Creek below the downstream monitoring point known as MG009.

MG009 is intended to provide information on any changes in water quality in the Magela system that might occur as the Magela flows past the mine site area and is augmented by wet season run-off, seepage, effluent and planned water releases. To do so, its results are compared with results from Magela Creek Upstream, MCUS, a site on the Magela that is well upstream of the mine site area.

Similarly, GCH provides information about any changes to the water quality in the Magela that might result from water quality changes in Gulungul Creek and its tributaries that rise in, or flow past, the mine site operation areas.

The statutory environmental monitoring regime imposed by RUM's mining licence required that these, and other sample points be monitored at a specified frequency and for specified chemical species. MG009, MCUS and GCH are designated as "monthly" sites and were analysed for uranium on that basis throughout the history of the mine.

TDSRC is not a statutory point whose testing is required by the licence. Like many other sample points, it was created as a part of Ranger's own monitoring programme. It was routinely sampled on a weekly basis.

In the cases of MG009 and GCH, which are "exit" sites sampled from pristine locations, the measured levels of chemical species related to uranium mining should be no higher that those at the corresponding "entry" sites. The only exception to this is when controlled water releases are in progress. These approved wet season releases from retention ponds are monitored in terms of the contribution to the total load in Magela Creek made by the released water. Thus, MG009 is compared with MCUS, but there is no corresponding entry point for GCH. It is important to note that Gulungal Creek has two tributaries that conflue upstream of GCH and downstream of the mine. These are not routinely monitored. The main arm of Gulungal Creek rises in pristine country to the south of the mine site and the smaller, wet season creek that conflues with the TDSRC tributary before the confluence with the main arm, rises in the feet of Mount Brockman, to the south east of the mine site. All three creeks are dry for much of the year.

As both unmonitored tributaries rise in pristine country, it was apparently assumed by those who designed both the Ranger internal and government statutory monitoring programmes that no deleterious contribution to the water quality of Magela Creek was to be expected from those ephemeral water courses other than the one that rises at TDSRC.

1.2 Water Quality Measurement, Standards and Background Levels.

Instruments used to measure the concentration of chemical species in water all have a minimum level below which they are incapable of measuring with confidence. This is known as the detection limit. Because the detection limit can therefore never be zero, very low results are conventionally recorded as "less than" the relevant detection limit. In the case of uranium, the measurement technique employed at the time was known as "kinetic phosphorescence". Its limit of detection was quoted as 0.1 microgrammes per litre, (µg/L, or, in chemists' shorthand, "parts per billion", ppb).

The accepted level of uranium at MCUS, MG009 and GCH was <0.1 ppb. Due to the then current limitations of computers, (they were unable to mix alpha and numeric characters in the same data string), the less than sign was never reported. Such results often appear as zero.

The area around the mine site is characterised by uranium mineralisation in the host rock, so some detectable level of uranium is to be expected in the natural course of events. In respect of surface water, in a climate where massive rainfall flushes and leaches the land annually, background levels are expected to be at or below detection limits. With respect to groundwater, the Jabiru town drinking water, drawn from the town bore, was monitored and frequently reported up to 2 ppb uranium. The drinking water at the mine site could be sourced from either of two bores. One of those, on the Brockman bore field, reported up to 5 ppb uranium. The other, some distance away to the north west, and drawing from a different aquifer again, reported much less. Thus, the accumulation of uranium in groundwaters is variable up to, say, 5 ppb, in the immediate region.

At the time, the recommended maximum level of uranium in potable water was 40 ppb. That was revised to 20 ppb a year or so later, and at least one of the reviewers has expressed the view that a more appropriate maximum level would be 10 ppb.

1.3 An Account of Relevant Events

In January, 1997, I performed the monthly sample collection and uranium analysis for statutory monitoring purposes. As was routine procedure, I acquired duplicate samples from all of the sites. Later, when analysing the samples, I was alerted to a possible problem when GCH reported 7 ppb uranium. I re-tested the sample several times, and then tested the duplicate sample several times. All the tests confirmed the initial value of 7 ppb.

As this was overwhelmingly the highest result I had personally seen for that site, I checked the data base for history and found that, of the previous 25 tests, 10 had reported results greater than zero. Of those, seven reported 1 ppb, and the remaining three reported 2, 7 and 11 ppb.

I reported the occurrence to the then Chief Chemist, Allan Ryan. I explained that I suspected the source of the higher than expected uranium levels, both now and in the history, might be the elevated uranium readings that were routinely recorded at TDSRC during the first flush rain events each wet season. I requested permission to sample the two unmonitored arms of the creek system feeding Gulungal at GCH to eliminate any other potentially contributing factors, and to venture further down-grade from TDSRC to sample the creek at various locations with the aim of monitoring the dilution suffered due to rainwater and confluences.

Permission was refused on the grounds that GCH was a monthly site and that we did not need to check it again until February. TDSRC was not statutory and would continue to be monitored on a weekly basis. Allan Ryan suggested that the result was most likely to reflect contamination in the sample or the analysis. He suggested that the result not be recorded on the database. I did not agree, and entered the result.

Neither did I obey his instruction fully. It was not possible to sample further from the lower Gulungul system, but, on my other routine sample acquisition runs I was able to acquire samples from various points on the TDSRC system. I did that on two occasions. The first was later on the same day as the 7 ppb GCH sample was acquired and the other was nineteen days later on 21/01/97. The results indicated that significant dilution was suffered during the overflow events. For example, 669 ppb U recorded at TDSCR was diluted by run-off to 7 ppb two kilometres down-stream in the upper Gulungal.

These results clearly established that a contribution to uranium concentration in Gulungal Creek was being made by the run-off from TDSRC. It was not possible to state the magnitude of the contribution because of the episodic operation of the system and the limited extant data.

It was accepted wisdom among the laboratory and hydrology field staff that there existed under the tailings dam wall, adjacent to TDSRC, a small spring. Assisted by the hydraulic pressure in the dam, the spring expressed "seepage" onto the toe of the dam wall. The toe consisted of crushed "waste rock" compacted around the foot of the wall. Essentially, waste rock is very low grade uranium ore. It is used as fill, in earthworks, or is stockpiled. It contains uranium, but is not rich enough to warrant processing.

The seepage of water and dissolved salts from the dam continues for the entire year, but is not visible at the surface during the dry season. This is because the large surface area of crushed waste rock, heated by the sun, evaporates the water rather quickly. That leaves the solute salts accumulating just below the surface of the toe. When the rains come, the first good flush dissolves and mobilises the salts and carries them into the perimeter drain, thence into TDSRC, off the mine site, and into the creek system as described above.

The seepage and spring theory was not without precedent or support. At the time, I was aware that the Northern Territory Department of Mines and Energy, (DME), had been concerned about the seepage at that point in the dam wall, and had required Ranger to shore it up with an increased "toe loading".

This was done with further quantities of fresh waste rock. It did not allay the seepage, but, being fresh, unleached rock, it provided a new reservoir of oxidised mineral salts for the next season's run-off to transport out into the environment via TDSRC. From the graph of TDSRC uranium values, (given as Figure 1.3), the effect might be seen in the difference between the peak readings in February 1997 and February 1998.

If one wanted to accurately establish the progress of this mechanism, one would need to be present to catch the peak of the first flush rain event of the season at TDSRC. Sampling should then continue at short time intervals at TDSRC1000, TDSRC2000, GCH, and at the confluences between them, in order to catch the diluted peak of the first flush event as it progressed through the creek system to the Magela. The initial rain event would produce the biggest slug of effluent as it would represent the accumulated dry season load. Subsequent rain events would encounter less salt load and the peaks would therefore be lower.

It is noticeable from the graph that each event features a major peak, but is accompanied by subsidiary peaks. This suggested that several slugs of contaminated effluent were mobilised in discrete rain events. All of this went into the creek system.

My chief concern was that, because of the monthly or weekly nature of the water quality snapshots we were acquiring, we had no measure of the magnitude of the problem at the entry end. Moreover, we were certainly not seeing the full extent of what was occurring downstream, and were therefore failing to appreciate the ultimate consequences for the surrounding environment.

At that time, (February 1997), the highest level recorded at TDSRC during routine monitoring was around 5000 ppb, of which, it seemed from the limited data available, only around 10 ppb remained at TDSRC2000. The main slug might be a great deal bigger than that. Its apprehension depended upon a sample being acquired at the right moment. Its magnitude depended on the amount of solute load and the volume of run-off available for dilution. Getting to the bottom of it was clearly going to require a good deal of time and effort to acquire and analyse closely-spaced sample sets. The design of the monitoring programme, and the availability of staff and resources, did not allow for the synchronisation of sample acquisition with the first TDSRC overflow event, much less the proper investigation required of both entry and exit sites.

Subsequently, in the wet season of 1997-8, a peak of nearly 10,000 ppb was recorded at TDSRC. To me, that result confirmed that the monitoring programme had a significant gap in it. Further alarmed, I summarised the problem, and made a personal representation to Mick Nolan, then the Senior Technical Officer in the Environmental Laboratory, and my direct supervisor. Mick Nolan undertook to look into the matter.

Mick Nolan wrote to me on 110298, (Figure 1.5), saying that he had looked into the history data and stated that he believed that the peak concentrations were showing a decreasing trend over the previous wet seasons and that the increase noted in that year was due to a combination of the new toe loading and earthworks on the southern side of the dam. He instructed that the monitoring of TDSRC would remain at weekly intervals, and proposed that the situation should be assessed again towards the end of the next dry season.

A copy was sent to Peter Woods, then 2IC of the RUM Environmental Department, and a former NT DME manager. PW replied with a copy to me, (Figure 1.6). PW agreed with MN and acknowledged that any effect would be seen at GCH by noting that measurements are taken at that site, and requesting that data for GCH be plotted against TDSRC and sent to him. Strangely, he goes on to say that he, "… assumes levels there [at GCH] have always been low."

PW and MN do not address the likelihood that a toe loading seepage of tailings water is contributing to water quality changes in the downstream environment. Neither do they acknowledge that there is a problem with routinely releasing water containing up to 10,000 ppb uranium into pristine creeks.

From the extant data, TDSRC reported 738 ppb at the pond and 392 ppb when it flowed under the fence to join the creek, (020197). On another occasion, (210197), the respective figures were 669 and 621. The solutes in the seepage and run-off suffer variable though significant dilution, but, irrespective of that dilution, an absolute amount of uranium is released. Put another way, I had no way of knowing the volume of water passing me as I took the sample. Neither did I know the volume of diluent water that was being added by rain, run-off and other creeks. What my test showed was that every litre of water leaving the site at the TDSRC fence contained 392 µg of uranium, (020197), and 621 µg of uranium, (210197).

In a monitored part of the external environment, such numbers would have threatened the operation of the mine.

PW should have known the history of GCH. The graph he requested never reached me, but I have produced a similar depiction in Figure 1.4. The data are clearly incomplete, but they are also clearly indicative that further investigation was warranted.

Within a report to shareholders in 1997-98, in a paragraph addressing environmental monitoring and compliance, the performance of the company is lauded. A sentence notes that only one reading above background was recorded, and that was regarded as "spurious".

1.5 Conclusions from the Perspective of an Analyst

RUM knowingly and routinely allowed heavily contaminated water to flow out of the mine site at TDSRC and into the surrounding environment in the catchment of Gulungul and Magela Creeks.

RUM did not report the instances where an indication of this was observed at GCH.

RUM discouraged investigation into the elevated level found at GCH in December, 1997.

Senior RUM Environmental Department personnel were alerted to the problem but did not regard it as serious and would not allocate resources to further investigation.

2. Tailings Spill in Corridor Road

2.1. Geography and Mine Hardware

Refer to Figure 2.1. Tailings slurry is pumped from the neutralisation plant to the tailings dam through pipes that are laid on the surface, at the verge of Corridor Road. On the outside of the road is a 25-odd metre wide strip of creek flats with native vegetation forming the east bank of Georgetown Greek. That ephemeral waterway feeds a major billabong in the wet season. Georgetown billabong in turn flows into Magela Creek.

Inside the road is the restricted release zone, (RRZ), from which the release of contaminants into the surrounding environment constitutes a reportable breach of RUM's licence to operate the mine. Those operations, although heavily regulated by statute, are largely self-regulated in every-day practice.

Running parallel to the road, on the inside, is a perimeter drain that is intended to collect run-off water from the surrounding mine site area and divert it to a turkey nest sump adjacent to the road. From that sump, the water is pumped to other retention ponds for storage, or disposed of via evaporation or authorised wet season releases. Depending upon its degree of contamination, the sump water could be pumped to the then disused Pit J or the tailings dam.

2.2 An Account of Some of the Relevant Events

On a Sunday evening in early December, 1997, my neighbour told me of a big spill of tailings from a ruptured pipe on the Corridor Road.

The neighbour was then a shift supervisor at the RUM plant. He had come on-shift at 0700 on the Saturday and found that a tailings line had ruptured and sprayed tailings slurry across the RRZ at Corridor Road, into all the perimeter drains along that section of the road, and up the outer bank of the turkey nest sump.

From the tailings system pump and lineout log, and from the amount of material spilled, he found that the line had ruptured during a routine line change, and that the ruptured flange had probably been discharging for around four hours before it was discovered.

As soon as I arrived for work on the next day, I went to the site. It had been raining most of the weekend, but was reasonably fine at the time. I saw the site much as my neighbour had described it. Any material that had been sprayed over the road onto the creek banks, outside the RRZ, had, by then, been removed. There was evidence of machinery having been used to excavate an area approximately 25 metres square and 250 mm deep, on average. The excavation extended from the foot of the road batter to the creek bank and had removed all vegetation. I estimated that approximately 156 cubic metres of material had been removed. Not all of that would have been spilled tailings slurry, but there must have been a substantial amount to have extended at whatever depth over the area excavated.

I was later told by Heather Baines-Thompson that several large tipper truck loads of material had been excavated and carted off to the contaminated waste dump.

HBT was operating a water cart that was being used to hose the heavy slurry back across the road and into the perimeter drains. Those drains were full of slurry and were carrying the overflow into the turkey nest sump. No attempt was being made to remove the slurry that had been sprayed up to half a metre up the sides of the motor control station operating the sump.

I returned to the environment laboratory and reported the spill to the Chief Chemist. I made clear my fears that an incomplete cleanup would become a health hazard for staff in the dry season. AR agreed, and said he would raise the matter with the Mine Department. An investigation was mounted in the laboratory to sample the creek at several locations, and to look for any effect downstream in Georgetown Billabong.

A couple of days later, I saw a statutory infringement letter from RUM to the DME and other stakeholders reporting the incident, and describing it. In that letter, PW stated that the amount of material that had been spilled outside the RRZ was one cubic metre, and that a full cleaned up had been performed immediately. As a result there was no environmental damage.

The material that had been sprayed or hosed into the perimeter drains and turkey nest remained where it was for the remainder of the wet season and most of the following dry. During the dry months, the sump was allowed to dry out and the fine tailings blew around in the wind. I was concerned for the health of my people who visited that site on a daily basis as a part of their monitoring roles, and again approached AR about the OH&S aspects of the failure to clean up the residue of tailings spills. He agreed, but again, no action was forthcoming to rectify the situation. I also raised the matter at meetings where were present the most senior management and environment staff on the site. The cleanup did not occur.

The following September, after another similar, though much smaller, spill occurred on the inside verge of the Corridor Road, I became concerned enough to write a duty of care letter to the new Chief Chemist, David Toohey, (Figure 2.1). In that document, I summarise the history of the problem and my efforts to get something done about it.

Among other fears, I wondered about the quality of water from that system that was usually sent to RP2 and subsequently released into the Magela during planned release events. If its quality was prejudiced by the contaminated material from the spill that was still laying in the drains and sump, it might not be suitable for release at all. That eventuality would raise enormous water management and storage problems.

My duty of care letter was written on 090998. On the morning I wrote the letter, I had seen the result of machines scraping the sump out. A large amount of tailings material remained in the dry sump and in the drains feeding it. I realised that, if the job was not done soon, the coming wet season rains would distribute the contamination further into the managed water inventory.

On 281098, only six weeks-odd after I wrote my duty of care letter, Ranger learned that it had problems with RP2. Ranger began investigating an alarming water balance calculation that indicated there were 340 kilogrammes of uranium in RP2 that were not supposed to be there. (Figure 2.2). That is, according to the records of the water management programme, that amount of uranium could not be accounted for. Chemical tests shortly after that showed 7000 ppb uranium in the pond. This means that every litre of water in the pond contained 7 milligrammes of uranium. It is a large water body. The level had reached 3000 ppb in the dry season that year but was usually well under the 1000 ppb level, and frequently less than 250 ppb, (Figure 2.3).

Subsequently, I saw a letter, (Figure 2.4), written on 021198, in which PW notifies the stakeholders of a small spill on the Corridor Road. PW notes that, although only a small quantity of material had been involved, and none had left the RRZ, he has concerns about small quantities that might have persisted and entered the sump, and which might later pose a water quality problem in respect of disposal into RP2 and thence into the Magela system.

2.3 Conclusions

RUM significantly understated the magnitude and extent of the tailings spill in December, 1997. The statutory report to the stakeholders stated that only one cubic metre had been spilled. For that to have been the case, the spilled material would have to have been spread over the 25 square metre area to a depth of only 1.6 millimetres. Given the nature of the spray from ruptured flanges, and that the leak was undetected for several hours, the scenario reported by Ranger is not possible.

Although the area outside the RRZ was cleaned up quickly, the affected area inside the road was left for nine months before a serious effort was made to remove the tailings material. Even that effort was not completed. This exposed staff and the environment to ongoing exposure to toxic materials.

In view of what was occurring concurrently in Retention Pond 2, the failure to clean up promptly probably did cause or contribute to subsequent water management problems.

3. Technical Matters Affecting the Function of the RUM Environment Laboratory

3.1 Introduction

The nature of this issue is highly technical. And it is riddled with jargon and convention. Some of the concepts and most of the argument will be foreign to persons who do not have a working acquaintance with analytical chemistry.

Rather than attempt to explain and justify each step in the logic behind the five technical issues, I shall confine myself to providing information on the potential environmental and statutory consequences of the failure to adhere to established best practice, and the terms of RUM's licence to operate the mine.

To support the validity of my points, I quote Ranger's own investigation into the matter. Ranger preferred to characterise my disagreements with the Chief Chemist as personal, rather than professional, and referred the matter to a "conflict resolution" process. That process engaged a senior scientific consultant to review the issues and adjudicate. Whilst I do not have a copy of his report, a letter to me from Ranger's Environment Superintendent, (given as Figure 3.3), clearly demonstrates that Ranger accepted the validity of the points I had made.

The issue reduces to Ranger's failure to operate within the provision of its licence which states, *inter alia*, and paraphrased, that Ranger shall maintain on the site a laboratory that is capable of being NATA registered. NATA is the national laboratory accreditation body. Among other things, it requires for registration that laboratories retain sufficient qualified and experienced staff who are fully conversant with the tests being performed, observe Australian Standards for the presentation and operation of methods used in chemical analysis, and maintain all of its equipment according to performance standards set out in the NATA regulations. The latter are, in turn, expressions of relevant Australian and international Standards.

That Ranger did not comply with the terms of its NATA registration did not necessarily cause inaccurate reporting. But in some instances, it definitely did, and in many more there is no way of knowing whether or not results were prejudiced. In the case of Alkalinity, the error was small and not frequently encountered. In that of Zinc, errors six times greater than the reporting limit were being propagated and reported. And in the case of TDS and the Balance, a result was reported that the test was not capable of measuring.

My contention here is that Ranger did not comply with the analytical best practice required by the regulatory authorities. That much can be demonstrated. It remains my opinion that there existed at Ranger the capability to adopt and operate best practice. During the tenure of my employment, there were sufficient competent analysts and appropriate instruments for the core Ranger tasks at hand. What was missing was the will to look more deeply into problems.

3.2 The Technical Issues

The text of the individual points, as presented to RUM management, is given as Figure 3.1. As stated above, this text can be somewhat obscure in places.

3.2.1 The Balance

Refer to Figure 3.1.1.

The balance is a critical and mandatory item of equipment. Most of the operations in a laboratory depend, at some point, on the traceability of accurately weighed amounts of various standard and other materials. All volumetric apparatus, for example, is calibrated against the mass of water it contains or expels at a certain temperature. The calibrations employed require four decimal places in the data.

At the time, a laboratory balance capable of that performance could have been purchased for around three thousand dollars, and be freighted to the site in a couple of days. That the then Chief Chemist did not replace the existing balance when it was condemned by a NATA-certified calibration engineer is inexplicable.

The accuracy of a balance is critical in the case of low level analyses, where the results are close to the limit of detection. In one case at Ranger, the fourth decimal place in the mass of the sample becomes the result. That is, every tenth of a milligram, (0.0001 g.), in the sample represents a whole milligram in the result. If the balance cannot see the fourth place, it is not possible to produce results that are less than 10 mg/L for that test. Ranger continued to report such results for some months after they had been made aware of the problem.

3.2.2 Radium

In this point, the failure to replace the failed balance propagated serious errors into the procedure for analysing radium. The scheme of the analysis is complicated, but essentially, the sample is inoculated with a very accurately weighed amount of a radioactive "tracer". The tracer is analysed as well as the radium, and its recovery is used to correct the empirical value obtained for radium. If the tracer cannot be weighed accurately, the remainder of the analysis cannot proceed with accuracy.

When the balance was condemned, it was not withdrawn from service for two months. When it was finally accepted that its performance was compromised, the balance was not replaced. Rather, a "pea and thimble" shuffle was employed to create the extra decimal place and thus include an order of magnitude in the result that was not predicated by the original data.

To do this, the Chief Chemist instructed that a three-place balance be used to weigh out approximately 2.000 grammes of the tracer, but to record it on the worksheet as 0.2000 grammes. The shuffle was completed by diluting the tracer by a factor of ten.

I was asked to do this and append my signature to the worksheet, and declined. I was then rotated off the radium bench and replaced with a very junior trainee.

To put the problem another way, If I weigh out 1.234 grammes of something and analyse it, I may not report a result which has more decimal places in it than the least accurate original base measurement. I may report, say, 5.6 ppb, 5.67 ppb or 5.678 ppb, but not 5.6789 ppb. Such a difference is small in absolute terms, but it is finite, and when introduced at the beginning of a calculation it can be multiplied manyfold and produce an erroneous result.

Initially, the strategy failed to produce the expected results. Months of work were found to be invalid. As it turned out, there had been an error in diluting the tracer. Because nothing was documented, the error was not trapped and eliminated. And because no test work was performed to validate the changes, the error was not detected until it had been propagated through Ranger statutory monitoring results and some of the baseline work for the Jabiluka EIS. When it was discovered, there was insufficient time to repeat the test work, so the results were mathematically corrected to remove the supposed tenfold error.

Other changes were made to the method in order to speed up the analysis. Refer to the text in Figure 3.1.3 for details. Deadlines were approaching for the Jabiluka EIS and there was a great deal of pressure on senior staff to get the results out.

None of the changes made were in accordance with NATA registration. Indeed, the text of the method itself must be approved by NATA before it can be used under the registration. The changes were not incorporated into the manual of methods.

3.2.3 Alkalinity

This point is entirely technical. The discussion given as Figure 3.1.3 amounts to the following:

The original method was correct and functional. It was re-written to reflect changes to reporting units and remained correct. It was further re-written to accommodate the use of a new model instrument and continued to remain correct.

The method was reviewed by a new staff chemist and altered to reflect a NATA requirement that intermediate calculations be shown on the worksheet as an aid to traceability. After that review the method was checked and went into service.

Unfortunately, an error had been introduced by the new chemist and not trapped in the checking process. This should not be possible if the NATA requirement for documented method validation had been followed, and the checking process had been complete and thorough.

When problems became apparent with a particular type of sample, I investigated and noticed the error. I followed it back to its source and wrote a report explaining the problem to the Chief Chemist. He could not see the validity of the stoichiometric argument, and declined my request for the method to be re-validated.

3.2.4 ICP Performance and Detection Limits

This point pertains to the well-accepted fact that machines do not always perform to the level stated in their advertised specifications. It is especially true for highly complex instrumentation where the set values of a large number of variable operating parameters, the skill levels of the operators, and the environmental conditions obtaining at the time of analysis can have a significant bearing on the ability of the instrument to perform satisfactorily.

NATA, and other quality control/assurance systems, require that the performance levels and detection limits be determined empirically on a regular basis. By continuous verification at set intervals, this ensures that changes in the analytical environment cannot adversely affect the results produced by the instrument.

Prior to the matter being raised by me, Ranger had not performed those checks. The results it was then producing for itself, and on a commercial basis for other mines in the NT, were published over performance and detection figures that were not documented, and indeed, seemed on inspection by a practiced eye, to be derived from literature values.

I performed a set of validation tests and reported to the Chief Chemist. The results were mixed. Some of the results we were producing were technically valid, but some were not. He was unwilling to acknowledge the validity of the theory, could not see that we were breaching the terms of our NATA registration, and would not agree to changes in the procedure that would rectify the situation and involve very little extra work for the analysts. He pointed out that our credibility would be greatly reduced if we suddenly produced a set of ICP performance numbers that were substantially different from those quoted over the previous years.

A major impetus for Ranger to ignore the very well-accepted standards and practices in respect of validation, must have been the pressure of commercial work that was not related to Ranger itself. At the time, laboratory management were contracting out analytical services to most of the mines in the Top End, and a few in other states. The laboratory also performed corporate environmental work for its parent company, North Ltd.

All of that was done in addition to the statutory work required for Ranger itself, and with no increase in human or instrumental resources provided by the company. Instruments were set to "one size fits all" operating conditions, calibration standards became cocktails containing numerous exotic minerals that were not relevant to the Ranger operation, and some staff members were working six and seven days a week to keep pace with the volume of work arriving from the surrounding mines, and to cope with their core functions at Ranger.

3.2.5 Zinc and Deionised Water, (DIW).

This point illustrates the reluctance of Ranger management to investigate and rectify problems and confront the consequences of error.

Essentially, I encountered a problem with the ICP analysis of zinc. Zinc is reported above a detection limit of 2 ppb, but some results required a correction, (for background in the DIW blanks), of up to 12 ppb. There were two possibilities, one in the water and another in the conditions obtaining in the instrument at the time.

As chemical analysis is dependent on comparisons with blanks, I investigated the DIW system and found brass fittings that were probably contributing zinc to the water. I was also aware of the matrix problems being experienced by the ICP itself, (refer to Section 3.2.4), and needed to perform further test work to isolate and rectify the ultimate cause of the problem. For the interim, I recommended that the DIW system be serviced and the brass replaced with plastic.

A number of previous investigations had produced a mixture of results, but the problem had persisted. It was an accepted fact in the Ranger laboratory – but not elsewhere – that zinc must be blank-corrected. That the situation could and should be addressed and resolved seemed to have a low priority.

Ultimately, the problem was addressed by installing a final polishing, or clean-up stage to the DIW system. This unit mopped up any zinc, and other species, in the product DIW, but did not eliminate its source. The inter-twined issue of the ICP background continuum that is capable of distorting zinc measurements was not addressed directly, although the cocktails were rationalised. Blank corrections continued to be applied to Ranger statutory work.

3.3 Discussion of Events

As previously indicated, Ranger chose to interpret technical disagreements as personal conflicts. The disagreement that I encountered in the Chief Chemist was referred to a mediation process.

A respected expert in environmental chemistry, Dr. David Jones, from Earth, Water and Life Sciences Pty. Ltd., (formerly ERA Environmental Services), adjudicated the issues raised and agreed that each had merit.

Andrew Jackson, Ranger's Environment Department Superintendent, acknowledged the merit of the issues but would not allow me to obtain a copy of Dr. Jones' report. (Refer to Figures 3.2 and 3.3). In a communication to me, Mr. Jackson ventured the view that, notwithstanding the merit, "... pragmatic decisions are required ... [and] ... the system may not be perfect at all times."

I would have thought that best practice at all times should be the yardstick in all industry, but especially in a uranium industry that is located in the middle of Kakadu National Park. The very low level presence of chemical species at which baseline analysis is directed will not be accurately quantified by other than best practice technique. That reality, in turn, has enormous ramifications for our understanding of the effect that industry has on the environment.

4. Post Script

The conflict resolution process ended in Februry, 1998. I continued to work in the environmental laboratory until December of 1998. At that time, an opportunity arose to work for another organisation outside the mining industry. I resigned from my position at Ranger of my own accord.

Where laboratory results have been quoted as real numbers in this statement, I have retained extracts from the laboratory data base to verify those numbers and correlate them with a sample site and a unique sequential sample number. In most cases, the date of the sample is also recorded. Those documents amount to columns of numbers and acronyms, however they can be made available for inspection and verification against the primary records, which latter should be on record at the Ranger environmental laboratory.

Geoffrey Kyle

Geoffrey Kyle.
5 April, 2002.