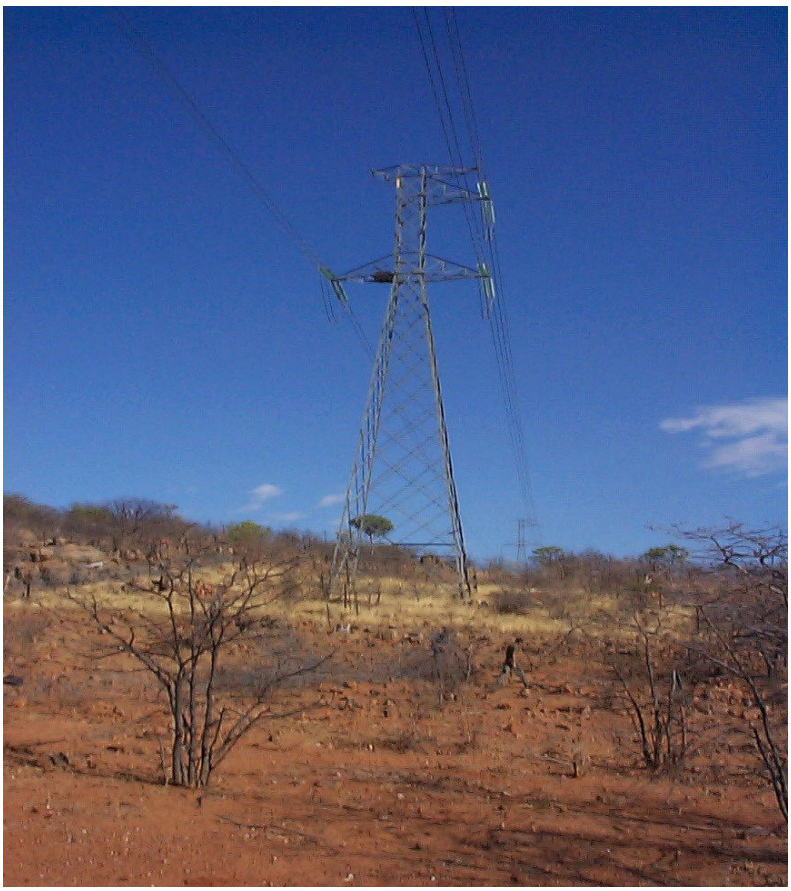
RUACANA POWERLINE MINE CLEARING PROJECT



Contributing Parties: Namibian Defence Force
Windhoeker Maschinenfabrik 1998
RONCO
Force XXI
Military International Limited
Report compiled by: Johan Dippenaar – MIL
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A. HISTORY.

Ruacana is a town situated on the northern Namibian border with Angola. Located near Ruacana is a hydro-electric power generation plant. This plant supplies electricity to a large part of Namibia via a network of high voltage pylons, as can be seen on the cover of this report.

The Ruacana dam that feeds the hydro-electric plant.

There are just over 400 of these pylons, which run from Ruacana southwards into the interior of the country.

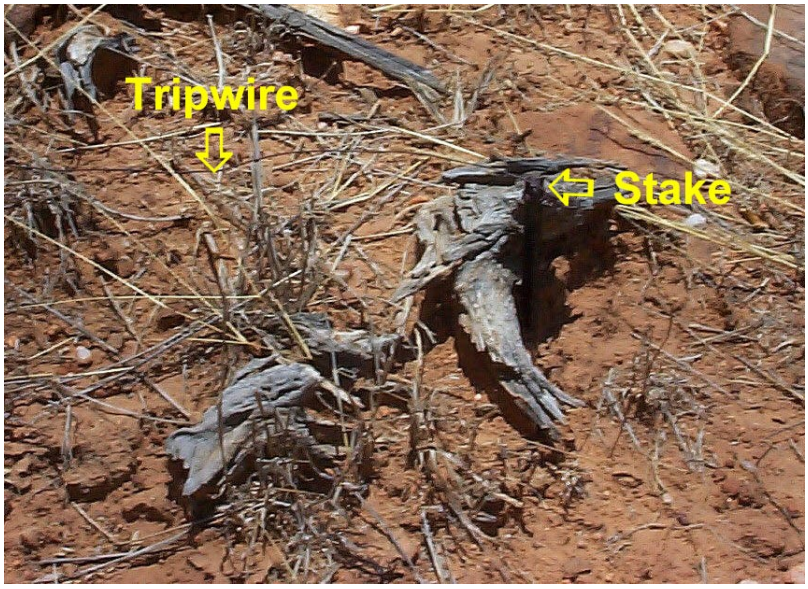
During the conflict years in Namibia the South African Defence Force (SADF) mined these pylons to protect them from attack by the Peoples Liberation Army Of Namibia (PLAN) Soldiers, the armed wing of SWAPO.

For this purpose the SADF used two types of anti-personnel mines. Firstly they used the R2M2 mine, which is a blast mine containing about 50 grams of RDX in a plastic housing. The R2M2 has virtually no metal content (apart from a small needle-like firing pin), which makes it very difficult to detect with conventional handheld mine detectors. The R2M2 is pressure detonated by about 5 pounds of pressure on the detonator. The R2M2 will not kill its victim but serious injury will definitely occur with possible loss of the leg in question and definite loss of the lower portion of the leg, below the knee.

R2M2 AP mine with safety pin in place over the detonator.

The second type of mine used by the SADF was the J69, which is a bounding fragmentation mine containing about 500 grams of RDX in a metal casing, lined with steel fragments. The J69 can be detonated by pressure or by means of a tripwire. Upon activation the J69 will bound about 1 metre high off the ground whereupon the primary detonation would occur, sending shrapnel in all directions. The lethality range of the J69 is 40 metres, with death a certain prospect. Serious injury can still occur out to about 60 metres.

Actual J69 AP Mine uncovered under one of the pylons. These mines are too unpredictable and lethal to handle and was therefore destroyed in-situ.



J69 tripwire and stake.

When the SADF pulled out, before Namibia got its independence in 1990, they left the minefields around the pylons intact. Although it is believed that maps of the minefields existed they were not made available to Namibia.
The minefields were however marked and fenced off with barbed wire.
A contractor was appointed after independence to clear the pylons, but his approach was entirely flawed and about the only thing he succeeded in doing, was to remove the demarcations and to spread the mines over a much larger area. Also, if any maps were made available now, it would be almost useless.
About 2 years ago Force XXI, a NGO out of the USA, was contracted with State Department funding to clear the pylons. Force XXI is headed by Will Haynes, an ex-US Special Forces NCO, who wrote the SOP's for peacetime mine clearing operations for the US Army.
Force XXI developed the correct techniques and principles and proceeded to clear the pylons. To date they have cleared around 380 of the pylons and they have recovered and destroyed literally thousands of mines. Their operation is clearly a resounding success.
During the last year the State Department got RONCO involved with the project, to the point where they became the Prime Contractor. In turn, RONCO contracted Force XXI to complete the project, and Will Haynes stayed on as Project Director to finish the job.
As the clearing operations moved further north, and closer to Ruacana, 7 pylons were identified as being problematic to clear, using the existing Force XXI techniques. These pylons were all situated in very difficult mountainous terrain and they were overgrown with vegetation.

B. <u>THE PROJECT.</u>

The 7 problem pylons proved difficult to clear because:

- They are located in such mountainous terrain that the Force XXI equipment could not be brought in for the clearing operation.
- The Force XXI clearing SOP could not be followed. The SOP comprised bulldozing the site whereafter the heap of contaminated soil would be sifted with a specialized processor to recover the mines. The mines would be removed manually from the processor and destroyed. This approach worked fine on the majority of the pylons where the soil was sandy. These 7 pylons

were however extremely rocky, which meant that the standard SOP would not be effective.

- The NDF deminers, who were deployed with Force XXI, would not go in and do manual clearing on the 7 pylons because it was rumoured that these pylons only contained J69 bounding fragmentation mines which were set with tripwires. Because of the dense vegetation in the minefields the tripwires were extremely difficult, if not impossible to identify, as can be seen on the photograph above. The risk of accidental detonation was therefore too high.

To find a viable solution, Force XXI consulted with RONCO, and a Consultant was sent in to study the problem. His proposed solution was to send in a team of detection dogs to locate the mines.
This was done, and a team of 9 Bosnian Handlers and their dogs were flown into Namibia. The team operated under the management of veteran Texan Dog Trainer, John Dennison. John studied the 7 pylons in question and concluded that the dogs could not be used in this situation because:

- The dogs are used for quality assurance on minefields already cleared. They are not used to detect mines in virgin minefields.
- The dogs are not used in minefields containing bounding fragmentation mines, such as the J69, under any circumstance.
- The dogs are not used in minefields where the mines are set with tripwires because they have no sensitivity to the wires, only explosives. The risk of accidental detonation was therefore unacceptable.
- The dogs could not be used in the 7 pylons due to the difficulty of the terrain. The concern was that the dogs would be too pre-occupied with finding their footing which would cause them to lose concentration and therefore diminish their capability in detecting the explosives.

John Dennison was absolutely correct in his analysis of the situation. The effort in bringing in the dogs was however not wasted, as they were used to do quality assurance on the 380 odd pylons already cleared by Force XXI. This exercise is continuing at present.

The question remained however, how to clear the 7 pylons?

Hannes Kögl came up with a proposal to use the Wer'wolf MKII, fitted with a combination of steel wheels and run-flat tyres. The concept would be to move into the minefields with the vehicle and literally drive up and down every square inch of accessible terrain to detonate any mines that were encountered, thereby mechanically clearing the terrain. The mechanical clearing would take care of the majority of mines buried around these pylons. On a secondary level, we expected that with the terrain churned up and with the vegetation destroyed, confidence would be gained by the NDF Deminers to move in afterwards to do manual clearing. Once cleared manually, and with all the vegetation and tripwires removed, the dogs could move in to do final quality assurance. In this way the pylons could be cleared completely.

Will Haines supported the concept as a possible solution, and a proposal was made to Gen. Martin Shalli, the Chief of Staff of the NDF, to obtain official status for the project. Gen. Shalli approved the project and provided funding for some essential project elements.

Gen. Shalli also appointed Col. John Nakaambo as his Representative to the project.

MIL got involved with the project due to a number of reasons.

- Firstly, we have marketed the Wer'wolf MPV as a vehicle suitable for mine detection and mine clearing operations. Yet, to date we have not done any actual mine clearing operations to prove the concept. As the Marketing Authority, we therefore provided input to the project and we observed whether the process was viable and conducted to internationally accepted principles and standards.
- Secondly, even though MIL is not directly involved in humanitarian demining operations, this project provided a unique opportunity for MIL to contribute directly to such an operation, in its own way, thereby fulfilling a social responsibility and contributing directly towards making the Ruacana District a safer place for the Namibians living there.
- Thirdly, due to the direct involvement of RONCO in this project, it was deemed a suitable and significant marketing opportunity for WMF 1998, MIL and the vehicle to this most important potential customer.
- Fourthly, the project offered a unique opportunity to obtain marketing material to compliment our existing portfolio.
- Lastly, due to MIL's existing capabilities and equipment, we provided the much needed essential camping equipment and accessories to make life a little more bearable for the team members in this most difficult terrain and circumstances.

Planning and preparations were undertaken with the run-flat inserts on order from Hutchinson in France and the steel wheels under fabrication by WMF 1998. After delays due to late delivery of the run-flats the project was commenced on Saturday 4th November 2000.

SATURDAY 4TH NOVEMBER 2000:

The entire day was spent travelling in convoy from Windhoek to the Force XXI base camp in the Ruacana District.
The convoy comprised the Wer'wolf MKII MPV in APC layout (the Indian trial vehicle, reworked and painted in desert camouflage colours), a Wer'wolf backup vehicle in Freight Carrier configuration, a service truck fitted with mobile crane, a rented 4x4 Nissan and the MIL Land Rover with off road camper/trailer in tow.
The evening was spent around the fire, going over the concept and debating all the difficulties and potential problems.
There was some scepticism as to whether the Wer'wolf would cope with the job at hand. The terrain was considered as severely difficult and there was even speculation as to whether Wer'wolf would be able to negotiate the terrain in getting to some of the pylons, much less work the pylons.
The only true confidence came from the members who had experienced and seen this vehicle in action during the Indian Army Trials.
Regardless of loyalties however, it was patently clear that this was a do or die situation. If the Wer'wolf could not do the job then there was no conceivable solution on how to clear these 7 pylons. Nobody had any alternatives to offer.

Wer'wolf MKII in desert camouflage colours.

SUNDAY 5TH NOVEMBER 2000:

The entire day was spent doing a full reconnaissance of the 7 pylons. It was mutually confirmed that the planned approach was indeed the only viable solution. The terrain would be extremely difficult but we were confident that the vehicle would cope. To illustrate our confidence we negotiated up the most difficult access road (track) to one of the pylons, and that with relative ease. This was the road that some of the members speculated we would not be able to negotiate at all. Indeed, the opinion was that no vehicle would get up to this particular pylon. The general sentiment was however a lot more optimistic around the campfire on Sunday night, after witnessing what was thought to be impossible.

The terrain would challenge any vehicle to the limits.

MONDAY 6TH NOVEMBER 2000:

We decided to locate our campsite in close proximity to the 7 pylons to obviate the need to travel in and out of the valley on a daily basis.
This meant however that we would have to be self-sufficient as there was no trace of civilization in this remote part of the world.
We spent the best part of the day moving up the valley and setting up camp. We also prepared the Wer'wolf by fitting the steel wheels and run flats. This would enable us to start the clearing operation first thing Tuesday morning.

The bush camp situated close to the pylons.

TUESDAY 7TH NOVEMBER 2000:

The Wer'wolf was fitted with steel wheels on the front axle and run flats on the rear axle in preparation of clearing the first pylon.


Midway through clearing the first pylon.

Detail of steel wheel construction.

Detail of run flat tyre._

The Wer'wolf Freight Carrier was used to clear the barbed wire fence.

The same procedure was adopted to clear each of the pylons:

- Firstly, the barbed wire fence was removed from the perimeter of the pylon to gain access.
- Secondly, the Wer'wolf was driven up and down and criss-cross over the soil, rocks and vegetation surrounding the pylon. Care was taken to cover the entire area. Trees inside the perimeter was driven over and flattened.
- The Wer'wolf Freight Carrier was kept on hand outside the minefield as a recovery vehicle, should the Wer'wolf working inside suffer a breakdown.
- Lastly, the terrain was thoroughly inspected by Will Haynes and the available NDF Representative.

The 1st pylon was cleared 100%, but unfortunately the vehicle broke down just as the job was completed. The universal joint on the final drive hub of the right front wheel shattered. The vehicle lost traction and as a result the rear wheels dug in. the vehicle had to be recovered by the Freight Carrier.
No mines were detonated or encountered for the day.

The 1st pylon being worked. Note the vegetation.

The final result of clearing pylon # 1.

Detail of how the vehicle worked pylon # 1.

The rear wheels dug in when the front axle broke down.

The damaged universal joint.

WEDNESDAY 8TH NOVEMBER 2000:

The entire day was spent in getting a new axle in from Windhoek and in changing the axles. The damaged axle could not be repaired on site and hence a new one was fitted. The damaged axle can however readily be repaired in a workshop with appropriate facilities.
It is not entirely clear why the universal joint shattered. The vehicle was not working exceptionally hard at the time of the failure. In fact, the vehicle handled the terrain with ease and did not seem to experience any kind of difficulty during the day.
From outside observation it did seem as if the steel wheels in front was having an adverse effect on the steering capabilities of the vehicle. This also seems quite clear when studying the video footage taken during the clearing exercise.
One point of speculation is the fact that the axle was MKI status. This was the reserve axle that was fitted in India after the blast trials were concluded. These axles were used in other vehicles before being shipped to India and hence their status in terms of wear and tear was unknown. We do know however that these axles worked extremely hard in India after the blast trials when they concluded the automotive trials. This extensive wear and tear could have been a factor, especially when linked to the other possible contributing factors outlined below.
These other factors, which could also play a significant role, include:

- The design of the protrusions on the steel wheels should be revised. The protrusions have an unduly high profile. They work very well as they almost seem to plough the soil over, yet they also increase the rolling resistance of the axle unnecessarily. They will do the job equally well, even if shortened by half the present height. All you need is the ground pressure to detonate any mines; you don't need to unearth the mines as well. Anyway, the increased rolling resistance could contribute to the universal joint failure.
- The outside diameter of the steel wheels is not the same as that of the normal rubber road wheels. This could also be a factor since the vehicle was fitted with rubber wheels on the rear axle. The possible problem here is the fact that the output ratio from the transfer gearbox is constant, but the roll radius of the 2 axles are different due to the different diameter wheels. This could cause the front axle to wind up after prolonged use with the resulting universal joint failing under stress, it being the weakest link in the drive train.

WMF would need to investigate this failure and determine the true and exact cause for rectification on future similar applications.

THURSDAY 9TH NOVEMBER 2000:

Along with the axle change the steel wheels on the front axle was removed and replaced with run flat wheels similar to those fitted to the rear axle.
The clearing of pylon # 1 was completed, as was the entire clearing of pylon # 2. Both operations were deemed an absolute success, even though no mines were detonated. There is uncertainty as to why no mines were detonated. There is speculation that the SADF only used J69 mines on these 7 pylons. Due to the difficult terrain, they used a few mines only, but they wanted a high level of affectivity, so they used the J69's since they could set them with tripwires thereby increasing the effective covering range substantially. Further speculation is that they removed the detonators from these mines when they withdrew from the area in view of their lethality. Whether these facts are true, is entirely unsure, but we did not detonate a single mine during the entire operation. We did uncover a J69 on pylon # 2 and upon examination we found the detonator had been removed. We detonated the J69 by placing a cone charge on top of it.

J69 without detonator buried on the left. Expired J69 housing and detonator on the right.

Will Haynes preparing the J69 for demolition.

The rest of the day was spent preparing pylon # 3 for clearing the next day. Whilst on our way to prepare pylon # 4 for clearing the new front axle broke down in exactly the same way as the first one.
The universal joint shattered in identical fashion whilst traversing up a ravine. This failure is a mystery, which I cannot explain readily. Admittedly, the ravine was not the easiest of slopes to negotiate, but I was inside the vehicle at the time of the failure and it was definitely not struggling. The front axle was MKII status and brand-new. The axle had also not worked with any steel wheels fitted to it. This ravine was traversed by normal 4x4 commercial vehicles on a regular basis without experiencing any problems. I can therefore not offer any possible reason for this failure, which I am sure, will be fully investigated by WMF 1998 and rectified, if necessary.

The section of the ravine where the axle failure occurred.

FRIDAY 10TH NOVEMBER 2000:

The entire day was spent in getting 2 new axles up from Windhoek and in replacing both the front and rear axles with new ones. We wanted to stop the project before the new axles were sent up because we didn't know why they were breaking. Will Haynes convinced us however to get the new axles and complete the job.
Will was very satisfied with the progress and with the results. The concept of deployment was working very well and proved to solve the operational problem, which had no clear solution up onto this point. In fact, Will Haynes was so satisfied with the results that he offered RONCO to pay for any repair costs, provided we finished the job.
This convinced the team to get the replacement axles in from Windhoek and to finish the project.

SATURDAY 11TH NOVEMBER 2000:

Pylons # 3 and # 4 were cleared successfully and without any further major breakdowns. The terrain proved to be extremely difficult and some minor damage occurred, such as one tyre that was damaged and some pneumatic hoses that were damaged. We detonated no mines but the terrain was cleared comprehensively and successfully.
Whilst clearing pylon # 4 we did simulate some AP mine detonations to test the effect on the run flat tyres and to get some suitable video footage. The damage to the tyre was minimal and the vehicle could continue to operate as planned for some considerable time before we replaced the wheel.

Pylon # 3. Note the steep slope.

Pylon # 4. Note the difficult terrain.

Pylon # 4. Note the dense vegetation.

Damage to the run flat tyre after an AP mine detonation.

SUNDAY 12TH NOVEMBER 2000:

After examination of pylons # 5, 6 and 7 it was mutually decided not to clear them mechanically. These pylons were situated on extremely steep slopes and consisted of almost solid rock bed. It was impossible to clear them by any mechanical means.
By this time we had received very favourable feedback from the NDF Deminers.
They were very satisfied with the result of the mechanical clearing operation, to such an extent that they were very positive and confident about going in to do the manual clearing. Previously, they would not even consider this possibility.
In view of this it was decided that these three pylons would be burned to remove the vegetation whereafter the NDF would clear them manually.
All parties were satisfied with the outcome of the project and it was agreed that the objectives were achieved in all respects.
The Wer'wolf provided a solution to a demining problem that was deemed unsolvable with the tools previously at hand.
Despite the axle problems the vehicle performed extremely well, given the challenge. Will Haynes remarked several times on the absolute ease with which the vehicle was performing in the minefields.
The project was mutually concluded as successful and we all departed for Windhoek.