APPENDIX B:
CONSTRUCTION PROCESS FOR TRANSMISSION LINES AND SUBSTATIONS

CONSTRUCTION PROCESS FOR TRANSMISSION LINES AND SUBSTATIONS

1. Construction Camps

The entire construction workforce is usually accommodated on a "construction camp" that will be situated at some point along the Transmission line route (refer to Photographs B1 and B2). The location is selected by the contractor who will take into account such aspects as access to the construction site, access to services, access to materials, etc. The contractor will enter into an agreement with a landowner for the establishment of the construction camp. The various teams will travel from the camp to the construction site each day. The site moves continuously with the progression of the line, so the teams will perhaps travel a greater distance to the site each time. All materials are stored at the construction camp with the exception of the steel towers (which may come direct from the factory) and concrete (unless the site is very remote, when concrete may be mixed on site). As a rule, there is usually one construction camp per 100 km of Transmission line.

2. Construction Process for Transmission Lines

The following construction process will be followed for the entire route of the new Transmission lines. Each activity will follow the previous one, such that at any one point an observer will see a chain of events with different working teams involved. At any one time, some or all of the different teams may be working at different points along the line. Construction of this line will take approximately 12 months to complete, and is anticipated to begin before the end of 2002.

Activity	Approx team size	Approx duration of activity at a point
1. Survey of the route	By air	-
2. Determination of the conductor type and Selection of best-suited conductor, towers, insulators, foundations • Define final centre line • Determine co-ordinates of each bend in the line • Undertake aerial survey to obtain an accurate profile of the area • Identify optimal tower sizes and positions	-	-
3. Final design of line and placement of towers	-	-
4. Issuing of tenders, and award of contract to construction companies	-	-

Activity	Approx team size	Approx duration of activity at a point
5. Vegetation clearance -centre line (light vehicle access required) • Clear vegetation along centre line, with the aid of a surveyor • Undertake vegetation clearing in accordance with the minimum standards to be used for vegetation clearing for the construction of the proposed new Transmission lines (Eskom, 2000)	5 - 15	1 - 2 days depending on local site conditions
6. Centre line pegging and identification of requirements and locations for new gate (light vehicle access required)	3	1 day
7. Access negotiations (light vehicle access required) • Develop and agree on an access plan (Eskom, contractor and landowner) • Agree to rehabilitation measures • Take photographs of pre-construction conditions of site • Establish access roads (where required)	1	1 day
8. New gate installation (light vehicle access required)	5	1 day
9. Vegetation clearance (tower positions) • Clear four strips (40 m x 40 m square for CRS towers and 20 m x 20 m for the self-supporting towers) for assembling and erection purposes at each tower position marked	5 - 15	1 - 2 days depending on local site conditions
10. Foundation nominations for main structure and anchors (heavy vehicle access required) • Check soil types to determine foundation requirements • Dig trial pits at main foundation points (usually using mechanical back-actor/auger method, although manual labour may be used)	5	2 days
11. Excavation of foundations (heavy vehicle access required) • Excavate foundations of up to 4 m x 4 m square and up to 4 m deep depending on soil conditions (mechanically where access to tower sites is readily available (refer to Photograph B3), and dug by hand where access is poor) • Cover or fence off foundation pit until foundation is poured (refer to Photograph B4)	15	2 days
12. Foundation steelwork –reinforcing (heavy vehicle access required) • Make up steelwork at base camp and transport to site by truck • Undertake fitting and wiring on site (limited welding on site)	10	2 days

Activity	Approx team size	Approx duration of activity at a point
13. Foundation (concrete) pouring (heavy vehicle access required) • Shuttering • Use of standard concrete truck • Where access problems exist, mix concrete on site • 28 day period required after concrete has been laid • Heavy usage of access/service roads during this stage	20	2 days
14. Delivery of tower steelwork (heavy vehicle access; extra long trucks used) • Deliver steelwork in sections and assemble on site (refer to Photograph B5) • Mark access roads clearly to ensure the correct tower is delivered to each site (as towers are individually designed for each location)	5	1 day
15. Assembly team/punching and painting (light vehicle access required) • Assemble steelwork on the ground • Punch nuts and paint with non-corrosive paint	10	3 days
16. Erection (abnormal load vehicle access required) • Final assembly of towers by cranes (minimum of 50 tons; refer to Photograph B6)	20	2 days
17. Stringing (abnormal load vehicle access required) • Place cable drums within servitude (refer to Photograph A6) • Undertake stringing in both directions (5 – 10 km can be strung from one station) • Working are at each drum will be as long as 130 m, but will be within the servitude area • Intensive vehicle activity is likely within the working area • Pilot tractor cable will place cable on the ground • Pull up cable through use of a pulley • Ensure conductors never tough the ground	50	7 days
18. Sag and tension (heavy vehicle access required) • Tension the line from each station to ensure that minimum ground clearance heights are achieved (i.e. 8,4 m for 400 kV lines)	10	3 days
19. Rehabilitation (heavy and light vehicle access required) • Continuous process throughout the construction phase • Will typically only commence after the first 100 towers are constructed • There is a one year guarantee on the contractors work during which rehabilitation must be concluded	5 - 15	2 – 10 days depending on local site conditions

Photograph B1: Typical construction camp

Photograph B2: Typical construction camp

Photograph B3: Drilling of foundations

Photograph B4: Cover over foundations

Photograph B5: Towers are erected on site

Photograph B6: Erection of towers by crane

3. Construction Process for Substations

The proposed new Ikaros Substation and the extensions to the existing Bighorn Substation will be constructed in the following simplified sequence:

Step 1: Determination of technically feasible alternatives
Step 2: EIA input into route selection
Step 3: Negotiation with affected landowners
Step 4: Survey of the site
Step 5: Design of substation
Step 6: Issuing of tenders and award of contract
Step 7: Vegetation clearance and construction of access roads (where required)
Step 8: Construction of terrace and foundations
Step 9: Assembly and erection of equipment
Step 10: Connection of conductors to equipment
Step 11: Rehabilitation of any disturbed areas and protection of erosion sensitive areas
Step 12: Testing and commissioning
Step 13: Continued maintenance

- *Timing:*

  Construction of the proposed new Ikaros Substation and extension to the existing Bighorn Substation will be undertaken over a period of at least 12 months.

- *Access/Service Roads:*

  Access/service roads are required by Eskom for the construction and maintenance phases. Bighorn Substation is currently accessed via an existing access/service road. This will be retained. Access to the proposed Ikaros Substation area would be from an existing tar road traversing the area linking the Rustenburg-Thabazimbi road (R510) to the Thekwane Township on the Turffontein farm.

- *On-going Maintenance:*

  The standard life-span of a substation and its associated components is approximately 25 years. During this period, on-going maintenance is performed, and components are replaced, which significantly extends the life-span beyond 25 years.