



JOB DEMANDS ANALYSIS

Company: Greater Vancouver Regional District **Location:** Annacis Island

Job Title: Sewer – Wastewater Electrician **Classification:** Regular Duty

Work Demand Level: Medium to Heavy

Purpose of Activities

The purpose of the duties of the Electrician is to manage all of the electrical equipment and processes in the wastewater plant (s) (Annacis Island, Lulu Island, Iona, Langley and Lion's Gate).

Tools and Equipment

The mechanic will use the following tools and equipment to perform their duties:

- Gloves.
- Safety Hat
- Safety Boots.
- Safety Vest.
- Electric cart.
- Variety of hand tools including pliers and screwdrivers.
- Flashlight
- Testing equipment (e.g., volt tester).

Usual Methods

The job varies substantially from day to day as they may be involved in smaller routine maintenance tasks or the installation or removal of pumps or engines. Essentially they are either doing work in the field, in the office or in the shop.

Most of the work involves using small tools (especially screwdrivers and pliers) and dealing with small wires in enclosed spaces (cabinets and panels).

They also replace hundreds of fluorescent light bulb tubes which involves climbing up and down ladders and working with the arms overhead for sustained periods of time. The heaviest work would involve lifting heavy components and pulling breakers that are nestled in panels (up to 30 kg).



They will occasionally have to pull wire through to a new component or piece of equipment. That activity can require extensive ladder work and sustained activity with the arms above shoulder height.

A considerable amount of work is paperwork, specifically rewriting diagrams and examining diagrams or manuals. This can be done either from sitting or standing and most of it is done in the office.

Usual Methods – Lockout

Electricians are the only individuals allowed to lockout electrical supply to equipment that is going to be maintained or repaired. This involves tracing the power supply from the equipment (using identifier tags and drawings) and then turning off the power. They will then place a lock on the control lever for the power.

Usual Methods – Plant Specific Issues

The plant they are working in can also dictate some of the demands of the work. Annacis (in particular) and Lulu are more spacious and feature more hoists and cranes. The newer pumps and motors are also set on higher footings so that it is not necessary to work as close to floor level. The older plants tend to be more congested and the equipment is often set lower to the ground. It is more likely that block and tackle will have to be used instead of using hoists and forklifts. Older plants may also have less accessible breakers and other electrical components which translates to increased load handling for the electrician.

Administrative Issues

Typically they work an eight - hour day from Monday to Friday (0600 – 1530 with 30 minute lunch and two breaks). Four electricians are working at any time with five total in the group. They rotate weekend standby coverage. Most of the work is conducted indoors (outdoors is possible but less likely) and can include exposure to raw sewage and the risk of dangerous gases (such as H₂S). They have assistance of labourers for some heavy tasks. They may have to travel between plants.

Activity Demand Variables

These variables are tasks that must be carried out by the employee and are implicitly or explicitly required as objectives of the job.



- Work with 69 and 12 Kilovolt power
- Work in some confined spaces.
- Walk over concrete and stairs.
- Climb up and down ladders.
- Exposure to sewage.
- Awkward equipment located close to the floor or overhead (equipment dictates posture).
- Duties typically assigned daily

Worker Decision Variables

These variables are the sub-routines and cognitive/physical decisions made by the worker in carrying out the objectives of the job.

- Choose postures for carrying out duties (e.g. lifting using hips and maintaining neutral spine, creative energy saving techniques).
- Planning of lifts and routes for carrying (limited).
- Limited planning of approach to repair job.
- Limited flexibility of break selection.
- Mode of transportation around site (electricians have dedicated covered cart for transport at Annacis plant).

Accommodative Considerations

1. Individual with spine related problems may have difficulty with the crouched and stooped postures as well as with occasional lifting activities and occasional prolonged sitting.
2. Upper extremity problems including the hand, wrist and elbow would be difficult to accommodate because of constant gripping and tool manipulation with force (especially in awkward postures).
3. Shoulder injuries may also be aggravated by tool use and elevated arm postures inherent in the job.
4. Individuals recovering from systemic illness or pacemakers should be carefully screened before entering this activity (working alone and exposure to energized lines and equipment).
5. Individuals who do not cope well in confined spaces or working alone would have difficulty with this position.
6. There is a long learning curve associated with the tasks that includes formal training.

Prepared By: Greg Hart, Kinesiologist

June 1, 2001



Summary of Stresses

Metabolic Stresses

These stresses can be highly variable with the majority of power being supplied through the aerobic energy system in reasonably fit individuals. Duties such as walking, sitting, crouching and kneeling would predominantly draw energy from this system. More concentrated activity like stair climbing (which can be common) will challenge the aerobic system more. A few activities require high levels of force production from a variety of muscle groups to pull breakers, to lift and move parts or to climb ladders. The power for these requirements would be primarily derived from the anaerobic metabolism and can be drawn upon frequently through the day for brief (usually less than 45 seconds) periods of time. The maximum energy demand is in the order of 5 METs (17.5 ml/kg/min).

Structural Stresses

There are a number of high risk exposures to the physical structures of the body in this job. Some are related to movement and some are related to postures.

Spine

There is obvious exposure to most of the spine, but more specifically to the lumbar and thoracic regions. This exposure can come from several different possibilities. The first is high anterior disc compression from flexed postures that can include supporting high loads great distances from the body in awkward locations. The second possibility is that of prolonged strain on the spinal ligaments from working in a kneeling position. This increases instability of the structures over time. A third possibility is a sudden shearing force when lifting or moving a heavy object or when a wrench pops off of a bolt. The last aspect is rotating motions which can occur in combination with the previous factors. This exposes the facet joints of the spine to damage as well as weakening the disc fibre integrity. If proper lifting technique is observed when lifting is required in comfortable spaces, the risk to the spine will be minimal even if the loads are high.

Shoulder and Upper Extremity

The shoulder joint has to contend with sustained flexed and abducted postures occasionally under load. The result is considerable joint instability with high joint compression and ligament strain in addition to probable temporary supraspinatus impingement from time to time. This is especially true for sustained overhead activities like bulb replacement and wire pulling. This posture can also lead to irritation in the Thoracic Outlet leading to possible neurovascular compression.



The muscles of the forearm and wrist are required to produce frequent and often constant moderate to maximal grip forces. This combined with the often pronated or deviated position of the joint can lead to carpal tunnel stress and tendinitis even previous to that. There is a lot of pinch grip activity using small tools and fitting wires into receptacles and components resulting in high loading over the tendons supplying the thumb and first two fingers.

Knee and Ankle

The knee absorbs considerable compressive stress in kneeling and crouching postures. Kneeling can place high loads against the patella (kneecap) when it is unsupported and the knee joint is 'open'. Crouching loads the ligaments in the joint past the critical stress limits of the connective tissue and can contribute to increased joint laxity over time. Anterior knee pain and the development of patello-femoral syndrome are likely in these individuals. Arthritic changes can also be expected in most workers.

The ankle joint is required to stabilize the body in balanced positions on ladders and pipes and in all joint directions. It is particularly vulnerable on the lateral aspect to sudden inversion of the foot on uneven surfaces.

INTERVENTIONS

Recommendations that could be implemented to increase productivity and lessen the risk of injury are listed below:

1. Mechanical assists should be utilized wherever possible to reduce dangerous loading in awkward spaces. Continued education in rigging techniques is vital.
2. Educate employees relative to creative movement technique to help limit exposures to unmanageable physiological stress.
3. Provide gloves that offer the required protection with minimal interference in sensation.
4. Knee pads should be provided to all workers to reduce heating and compression of the knee joint.
5. Active whole body conditioning would be the best protection against injury as the nature of the job places many unmanageable stresses on many structures.

Ensuring that the tissue is strong and flexible and that energy delivery is efficient would be a critical recommendation.

6. The final recommendation involves moving from the sedentary activities of sitting or standing to a labour intensive task. Time should be taken to put the muscles and joints of the torso, hip and shoulder region through a full range of motion and to increase muscle and joint temperatures. This insures adequate preparation of body structures to effectively and safely participate in the required activities.

PJDC-WWTP Electrician

Referral: Mike Arcand		Organization: GVRD							Title: WWTP Electrician	
Dept.: WWTP		Division: WWTP							Contact: Mike Arcand	
PHYSICAL DEMANDS		R E Q U I R E D	S I D E	FREQUENCY*				Max. Weight (kg)	Usual Weight (kg)	COMMENTS
				Sel 1	Low 2	Mod 3	High 4			
S T R E N G T H	Lifting - Floor to Knuckle		B		X			25	< 5	Panel covers, hand tools, components, breaker
	Lifting - Knuckle to Waist		B		X			25	<5	Panel covers, breakers, components, bulbs
	Lifting - Waist to Shoulder		B			X		10	<5	Wire, fluorescent bulbs, components
	Lifting - Over Head		D			X		20	arm+	Fluorescent bulbs, pulling wire
	Carrying - With Handles									
	Carrying - Without Handles		D			X		10	<5	Parts, components, tool pouch < 100 metres
	Pushing - Upper Extremity		B		X			15	5	Some tool use, opening/closing switches
	Pushing - Hip/Leg Assist		B		X			25	10	Pushing in breakers and other components
	Pulling - Upper Extremity		B			X		15	5	Some tool use, opening/closing switches,steer
	Pulling - Hip/Leg Assist		B		X			35	10	Pulling out a breaker
	Reach - Shoulder or Above		D		X			arm +	arm +	Bulb change, overhead hand tool use
	Reach - Sho. or Above extnd		D		X			arm +	arm+	Bulb change, overhead hand tool use
	Reach - Below Shoulder		B		X			5	arm+	Reaching in to deep panels for tool work
	Reach - Bel. Shoulder extnd		B			X		5	arm+	Reaching in to deep panels for tool work
E N R G P O S T U R E + M O B I L I T Y G E N I R E G U L A R	Handling		B				X	max.	mod	Panel covers, hand tools, components, locks
	Gripping		B				X	max.	high	Tools (especially screwdrivers), parts, pinch grip
	Fine Finger Movements		B			X		high	low	Small bolts/nuts, wires(twisting), keys, locks
	Aerobic (percent)						90	Walking, light climbing, standing, sitting, low level tool work		
	Anaerobic (percent)			10				Full body exertion in lifting, pull/pushing, climbing		
	High Energy Expenditure					X		Occasional full body activity		
	Low Energy Expenditure						X	Walking, desk/bench work, travelling		
	Neck - Static Flexion					X		Some repair tasks in panels, examine diagrams, paperwork		
	Neck - Static Neutral						X	While walking, standing		
	Neck - Static Extension				X			Can be prolonged when working overhead		
	Neck - Rotation		B			X		Normal movement, see around objects in panel		
	Throwing									
	Sitting					X		Reworking drawings and other paperwork		
	Standing					X		On concrete surfaces		
	Walking					X		Almost always over concrete, grass and other uneven surfaces		
Running/Jumping				X			Over obstructions, on/off ladders (< 1m)			
Climbing - Arms and Legs				X			Ladders and scaffolding			
Climbing - Legs Only					X		Stairs (up to six flights) and step up onto raised areas			
Bending/Stooping				X			Work on awkward low level panel tasks, motors + pumps			
Crouching				X			Work on awkward low level panel tasks, motors + pumps			
Kneeling				X			Tasks at ground (concrete or metal) level, prolonged at times			
Crawling			X				Into and out of confined spaces, access awkward locations			
Twisting				X			Working around some awkward equip., in/out con. space			
Balancing				X			On ladders, scaffolds and pipes (often holding things)			
Traveling				X			Around plant in cart, truck, bike, occ. Offsite in half ton			
Work Alone					X		Dependent on job , it is possible - radio contact			
Interact with Public			X				Rare except on tours or driving off-site			
Operate Equip/Machinery					X		Electrical panels, breakers, engines, carts, testing equipment			
Irregular/Extended Hours			X				In emergencies, on call weekends (rotated)			

* Frequency Legend 1 = Seldom; Not Daily 2 = Low Daily Activity; < 1hr
 3 = Moderate Demand; Repetition 1 - 3 hrs daily 4 = High Frequency Demand; Repetition > 3 hrs daily
 The following shading denotes a HIGH RISK TASK: Modifications should be considered

REQD is marked with an X if the particular demand or category is relevant to the purpose of the job.

SIDE refers to the side or limb required to execute a task. If it is marked **E**, it indicates either side, the most common choice is listed first. **D** refers to dominant and **B** to both sides.

Referral:		Organization:		Title: see 1st page header				
Dept.:		Division:		Contact:				
PHYSICAL DEMANDS		R E Q U I R E D	S I D E	FREQUENCY*				COMMENTS
				Sel. 1	Low 2	Mod. 3	High 4	
P E R C E P T I O N	Hearing - Conversations		B				X	Communicating with co-workers
	Hearing - Other Sounds		B				X	Pumps, motors, alarms, power sources etc
	Vision - Far						X	Most tasks
	Vision - Near					X		Small, detailed adjustments
	Vision - Colour					X		Pipes, motor wiring are colour coded
	Vision - Depth					X		Judging distance, often in poorly lit areas
	Perception - Spatial					X		Need to understand relative object position
	Perception - Form					X		Differentiate between fittings and tools with small differences
	Feeling (Tactile)					X		Grip adjustment through gloves
	Reading				X			Work orders, signs, diagrams, manuals
W O R K E N V I R O N M E N T P S Y C H O L O G Y	Writing				X			Re-writing diagrams
	Speech					X		Communicating with co-workers
	Inside Work					X		Buildings, tunnels, occ. digester, underground
	Outside Work				X			Moving between buildings, outside repairs
	Hot Conditions >25 deg. C					X		Depending on the part of the plant, esp. engines
	Cold Conditions <10 deg.C			X				Outside work during winter
	Humid			X				Occasionally
	Dust				X			Plant is very clean, just in some confined areas
	Vapor Fumes					X		Exhaust, sewage (H2S,Meth.)
	Hazardous Machines					X		Pumps, motors, crane, fans, mechanical skimmers etc.
	Proximity to Moving Object				X			Forklift, floor scrubber, overhead crane, trucks, bikes
	Noise					X		Varies to above 110Db (protection required)
	Electrical Hazard					X		Always delaing with live current (12 and 69 Kv)
	Sharp Tools				X			Cutting tools, exposed metal and fragments
	Radiant/Thermal Energy					X		Motors, pipes, pumps, welding equip., hot wiring, transformers
	Slippery Conditions					X		Working in wet areas, near leaks etc.
	Vibration and Related				X			Hose, hammer
	Chemical Irritants					X		Cleaners
	Organic Substances					X		Raw or partially processed sewage
	Medical Waste			X				Possible at headworks
Blood Products			X				Unlikely, although technically possible	
Congested Worksite					X		Many confined areas - training req'd	
P S Y C H O L O G Y	Lighting - Direct					X		Overhead incandescent, daylight
	Lighting - Indirect					X		Reflected light
P S Y C H O L O G Y	Consequences of Error					X		Extreme ranging from power outage to electrocution
	Competence Challenge				X			Upgrading diagrams, changing patterns of energizing equip.
	Autonomy					X		Decisions about specifics of the job not about which job to do
C	Relatedness				X			Limited team work required, have to get along with co-workers

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For detailed descriptions of each of the different categories, please refer to the reference guide or inquire with Human Effort at 1-888-4EFFORT