Physical Demands Analysis – Bulldozer Operator  
Last Revised: December 4, 2008

ESSENTIAL DUTIES

1. Operating the Bulldozer
   A) Sitting
   B) Handling Controls
   C) Operating Foot Pedals

2. Getting On/Off the Bulldozer

3. Gaining Access to and Exiting the Ship’s Hold

4. Pre-Operation Inspection

Shift Schedule:

At Neptune Terminals, Bulldozer operators work around the clock on 8hr shifts. At Fibreco, the operators may work on day shift only or around the clock (same as Neptune Terminals) as per demand.

If working inside a salt vessel, 8 operators may be dispatched, with 6 bulldozers on the vessel. The operators work a 2 hours on/2 hours off schedule. However, in some cases, the offload may be a continuous operation.

The 8 hour shifts are from 8am-4:30pm and 4:30pm-1am with a 30 minute scheduled lunch break and two 10 minute coffee breaks. There is also a graveyard shift of 6.5 hrs from 1am-8am with a 1/2hr lunch break.

For continuous operations, three operators are dispatched to two Bulldozer Operator positions. Each worker operates the Bulldozer for approximately 2hr40min and then has a 1hr20min break.

Staffing:

At Neptune Terminals, this job is performed continuously. Rather than standard breaks, three operators are dispatched to two Bulldozer Operator positions and follow the break schedule above.

At Fibreco, Bulldozer operators are dispatched as per demand. This may require from 1 to 3 workers. If one worker is dispatched, they will follow the standard break schedule (two 15 minute breaks and a 30 minute lunch). If three are dispatched, they will follow the continuous operation schedule above (2hr40min on/1hr20min off).
DESCRIPTION OF ESSENTIAL DUTIES

1. OPERATING THE BULLDOZER

Frequency
- Operates the Bulldozer for up to 5.33 hrs out of an 8-hour shift.
- The operators drive for 2hr40min and have a break for 1hr20min.
- If the operation is not continuous, the operators drive 2 hours on and then break for 2 hours.

Equipment
- Caterpillar D10T Bulldozer

Task Description
- The Bulldozer is a piece of heavy equipment used to push large volumes of material. At Neptune terminals, it is used to push coal away from and toward the stacker/reclaimer.
- When product is being delivered to the storage area, the Bulldozers continuously move backward and forward pushing the coal away from the coal being delivered by the ‘Stacker’.
- When unloading onto a ship, the Bulldozers continuously push the coal toward the ‘Reclaimer’ that scoops up the coal and delivers it to the conveyor system travelling to the ship.
- When loading a ship, the Bulldozers push the material to the corners of the hold (trimming).
- Generally speaking, when in operation, the Bulldozers are generally moving straight ahead or straight back.
- Approximately 66% of driving time going forward, 33% backward (drive slower/in lower gear going forward because the bulldozer is pushing).

<table>
<thead>
<tr>
<th>A</th>
<th>SITTING</th>
<th>Equipment</th>
<th>Bulldozer Seat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>5hr 20 min total/shift</td>
<td>Frequency</td>
<td>Sustained (2hr40min)</td>
</tr>
</tbody>
</table>

Task Overview
- Frequent rotation of the neck to the left or right when looking around work area.
- Maximal rotation of the neck to the left and right when driving backward.
- Frequent neck flexion and extension when looking at controls and at the edges of the blade.
- The operator is seated for the duration of the operating task.
- Whole-body vibration when Bulldozer is in operation.
- Significant jolts and bumps when the Bulldozer is travelling or performing forceful movements. Bumps may occur when driving and looking backward, especially when driving over edges.
- Bulldozer seat is adjustable
### HANDLING CONTROLS

<table>
<thead>
<tr>
<th>Duration</th>
<th>Frequency</th>
<th>Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 5hr 20min</td>
<td>Constant when operating</td>
<td>Minimal</td>
</tr>
</tbody>
</table>

**Equipment** Joysticks, button controls, triggers

### Task Overview

- Each Bulldozer has a joystick control on the right side of the operator and a handle on the left side of the operator.
- The controls on the left control forward and reverse.
- The controls on the right hand control the blade (up/down/tilt)
- The controls on the left hand are electric whereas the controls on the right are hydraulic. Force required is minimal.
- As well, there are many other switch controls that are used very infrequently (heat, radio, many others).
- The primary grip for the joystick and left handed controls is a power grip.
- Wrist postures and angles vary depending on the movements.
- The arms are usually supported by the arm rests.
- Complex small wrist movements in all directions may be required to manipulate the right handed controls. The left handed controls are primarily operated using the index and middle finger.
- The left joystick controls also has a thumb actuated trigger that is used for ...
- There are significant dexterity requirements to make fine adjustments to the Bulldozer blade.
OPERATING FOOT PEDAL

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Travel Control Pedal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>up to 5 hr 20min</td>
</tr>
<tr>
<td>Frequency</td>
<td>Intermittent when operating</td>
</tr>
<tr>
<td>Force</td>
<td>Minimal</td>
</tr>
</tbody>
</table>

**Task Overview**

- There are two foot pedals on the floor of the Bulldozer cab. The foot controls are depressed to steer the machine by reducing the speed of the associated track (right brake slows right track, and the machine turns right; same for the left brake).
- Operating the foot pedals requires ankle flexion and extension.

**FUNCTIONAL DEMANDS with MSI POTENTIAL**

**Operating the Bulldozer**

**Neck**

- Static neck rotation in the horizontal plane when driving backward.
- Static sitting posture for long periods while focusing intensely on the terrain and equipment. Head forward posture was observed.

**Shoulder**

- Static sitting with the shoulders at different levels.
- Due to the type of controls, some operators prefer to keep the elbow rest lower on the right side than on the left.
- Intermittent holding of the elbow away from the side of the body when pushing outward on the joystick controls.
- Shoulder extension may occur when pulling back on the joystick.

**Elbow/Wrist/Hand**

- Complex small wrist movements are required in all directions to operate the joystick control.
- Repetitive thumb and finger movements are required to push buttons on the left and right handed control.
- Static wrist flexion of the left hand may occur when operating the left handed control.
- Static thumb extension on joystick can stress the structures around the base of the thumb.
STRATEGIES TO MINIMIZE MSI

Operating the Bulldozer

Neck
- Stretch the neck muscles often to allow tissue recovery resulting from awkward postures. Try tucking the chin to place the neck in proper alignment with the spinal column and then rotate the head to one side or the other. Hold the stretch for 20 seconds.
- When driving backward, try to turn the hips in the seat and get rotation from all parts of the back rather than just from the neck.

Back
- As much as possible, avoid sitting for extended periods of time to minimize static use of back muscles. Stand and stretch whenever possible.
- Take the opportunity to stretch or walk during scheduled breaks to restore blood flow to the spinal tissues.
- Minimize awkward sitting posture by taking the time to adjust seat for best fit before starting work.
- Reverse forward leaning postures by arcing the back, squeezing the shoulder blades together and sticking the chest out (see picture at right).

Shoulders
- Take hands off the joystick whenever not operating the controls. Let shoulders relax and hands rest in lap until required to reach back for joystick again.
- Sit as far back in the seat as possible to reduce the distance needed to reach behind to access the controls.
- Use elbow rests to reduce static unsupported postures of the shoulders when operating the joysticks and hand controls.
- Stretch the chest muscles to allow recovery from static postures. Sit back in the seat and combine the neck stretch with a chest stretch by interlocking your fingers behind your head and squeezing your shoulder blades together. Hold for 20s.

Elbow/Wrist
- Maintain neutral wrist posture when operating joystick and controls. Where possible use a power grip on the joystick to reduce stresses to the small structures in the hand.
- Let go of the joystick whenever possible to reduce static grip stresses to the elbow, hand and forearm.
- Avoid static postures of the fingers when grasping the joystick or when waiting to engage a control. Try to keep the muscles of the hand and wrist relaxed whenever possible.
- Perform wrist and forearm stretches with elbow straight to stretch muscles and increase blood flow after periods of particularly repetitive or prolonged static wrist and hand postures.
2. **Ascending and Descending the Bulldozer**

**Frequency**
- Two or three times per shift depending on how the operators have structured their breaks.

**Equipment**
- None

**Task Description**
- When on the ground, the Bulldozer Operators climb onto the machine using a combination of foot and handholds including the track.
- When accessing a Bulldozer inside a vessel, the operator may be required to climb onto the side of the machine, maintain balance and walk along the side of the machine in order to access the cab.

<table>
<thead>
<tr>
<th>ASCENDING &amp; DESCENDING THE BULLDOZER</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration: 1-2 minutes</td>
<td>None</td>
</tr>
<tr>
<td>Frequency: 2-3 times/shift</td>
<td>Minimal</td>
</tr>
</tbody>
</table>

**Functional Demands with MSI Potential**

**Ascending & Descending the Bulldozer**

**Neck**
- Significant neck flexion or rotation may occur as the operator looks down to ensure his footing when climbing on/off the machine.

**Shoulder**
- Overhead reaching is required when climbing up the side of the machine. This can stress structures in the shoulders and arms.
- When accessing the machine inside a vessel, the operator may use long reaches in order to maintain three points of contact.

**Hip/Knee**
- Supporting body weight against the force of gravity when ascending and descending stairs or ladder can put stress on the structures around the knee.
- Impact force descending the last step of the ladder can put stress on the structures around the knee, particularly if jumping down from bottom step.
- Significant hip and knee flexion when climbing onto the machine.
STRATEGIES TO MINIMIZE MSI

Ascending & Descending the Bulldozer

Neck
- Avoid sustained neck flexion when ascending or descending the stairs and ladders. Check footing then return to looking in front when climbing up/down.

Shoulder
- Avoid extreme overhead reaching when climbing ladders. Keep arm in close to the side of the body to increase stability through the shoulder joint.

Knee
- Clear footholds of debris before climbing onto the machine.
- Maintain balance and beware of debris or precipitation on footholds.
- Avoid jumping down from bottom step to reduce stress to the knee.
- Always use three point contact when getting on or off of the Bulldozer.

3. GAINING ACCESS TO/EXITING THE SHIP’S HOLD

Frequency
- Two or six times per shift depending on need. Frequency may vary depending on the needs of the crane operator. Sometimes the crane operator will put a Bulldozer into a ship hold to ‘break up’ the crust/top of the pile and then lift the Bulldozer to the next. This may be repeated during the day.

Equipment
- None

Task Description
- If a Bulldozer is needed inside a vessel, the crane (e.g. Red Dog Crane) will be used to lift a Bulldozer from the dock to the inside of the ship’s hold.
- The operator drives the Bulldozer to the ship and then exits the Bulldozer, accessing the hold through the ship. This requires travel by foot up the gangway, through the interior passageways of the vessel, through a hatch and then down a series of ladders/stairs to access the ship’s hold.
- Once inside the ship’s hold, the operator must walk over the loose bulk product (e.g. zinc) and then ascend the Bulldozer. Once the hold is empty or full (depending on the task being performed), the operator is required to reverse this course, climbing series of stairs and ladders to exit the ship and to return to the dock to retrieve the Bulldozer.
GAINING ACCESS TO/ EXITING THE SHIP’S HOLD

<table>
<thead>
<tr>
<th>Equipment</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>5-10 minutes</td>
</tr>
<tr>
<td>Frequency</td>
<td>2-6 times/shift</td>
</tr>
<tr>
<td>Force</td>
<td>Body Weight</td>
</tr>
</tbody>
</table>

FUNCTIONAL DEMANDS WITH MSI POTENTIAL
Gaining Access to/ Exiting the Ship’s Hold

**Neck**
- Significant neck flexion, extension or rotation may occur as the operator looks down to ensure his footing when climbing up/down ladders.

**Shoulder**
- Overhead reaching is required when climbing up/down ladders. This can stress structures in the shoulders and arms.

**Knee**
- Supporting body weight against the force of gravity when ascending and descending stairs or ladder can put stress on the structures around the knee.
- Impact force descending the last step of the ladder can put stress on the structures around the knee, particularly if jumping down from bottom step.
**STRATEGIES TO MINIMIZE MSI**

Gaining Access to/ Exiting the Ship’s Hold

**Neck**
- Avoid sustained neck flexion when ascending or descending the stairs and ladders. Check footing then return to looking in front when climbing up/down.

**Shoulder**
- Avoid extreme overhead reaching when climbing ladders. Keep arm in close to the side of the body to increase stability through the shoulder joint.

**Knee**
- Use hand rail or ladder rungs to help with balance and to assist in pulling up body weight when ascending or to slow rate of descent when coming down the stairs or ladder.
- Avoid jumping down from bottom step to reduce stress to the knee.
- Always use three point contact when ascending or descending the ladders or stairs.

### 4. PERFORMING THE PRE-OPERATION INSPECTION

**Frequency**
- Each time the operator accesses the Bulldozer. May be 1-3 times a day depending on the operators have structured their breaks.

**Equipment**
- None

**Task Description**
- Operators perform a visual inspection of the Bulldozer by walking around the equipment. Operators are looking for major mechanical issues (oil leaks, equipment damage).

**NOTE:** The joint ranges of motion required to perform the visual inspection is significantly less than the postural ranges required to ascend the Bulldozer. As well, the operator is free to use a variety of different body postures to perform the visual inspection so MSI risks for this task are relatively low.

<table>
<thead>
<tr>
<th>PRE-OPERATION INSPECTION</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>1-2 minutes</td>
</tr>
</tbody>
</table>

**FUNCTIONAL DEMANDS WITH MSI POTENTIAL**

**Performing Pre-Operation Inspection**

**Neck**
- Neck flexion may occur as the operator looks down to assess the condition of the tracks.

**Back**
- Bending and stooping may be required to assess the condition of tracks

**Shoulder**
- Above shoulder reaching may be required if the operator decides to look more closely at a potential problem with the engine or with the articulating arm.
STRATEGIES TO MINIMIZE MSI
Performing Pre-Operation Inspection

Neck
- Avoid sustained neck flexion when performing assessments. Look down briefly and then move head back into a neutral position once area is visually inspected.

Back
- Avoid twisting or bending the back when assessing low parts of the Bulldozer. Instead keep inward curve in the low back and go down on 1 knee to assess low areas. Move feet rather than twisting back when turning to inspect other areas.

Shoulder
- Keep arm close to the side of the body and avoid overhead reaching as much as possible.

5. ENVIRONMENTAL CONSIDERATIONS

Exposure to Elements
- The operator is inside the Bulldozer cab for the duration of the time he/she is operating the machine. The operator is exposed to the elements when ascending/descending the Bulldozer and when performing the pre-operation inspection.

Uneven Surfaces
- The Bulldozer is constantly moving over uneven surfaces which increases the bumps and jolts inside the cab.

Vibration
- The operator is exposed to whole body vibration throughout operation of the Bulldozer. There are also significant bumps and jolts as the Bulldozer changes direction, particularly if moving up and over piles of bulk material.

Other (Hazardous Materials)
- PPE is required due to the types of products being handled. Workboots, Hi-Vis vests, respirators, dust masks, gloves, white coveralls and hardhats are frequently worn.
- The operator is also exposed to exhaust from the Bulldozer, dust from chip piles (sensitizer) and particulate in the air when working.
# 6. Physical Demands Summary Table

<table>
<thead>
<tr>
<th>Job Demands</th>
<th>Max. Weight/Avg. Weight (Kg)</th>
<th>Duration per exposure</th>
<th>Frequency</th>
<th>UNABLE to perform</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifting/Carry</td>
<td>5</td>
<td>R</td>
<td></td>
<td></td>
<td>Fire extinguisher if needed.</td>
</tr>
<tr>
<td>Push/Pull</td>
<td>5/3</td>
<td>&lt;10s</td>
<td>F/C</td>
<td></td>
<td>Complex small movements of joystick forward and back, and gross movement to open/close cab door.</td>
</tr>
<tr>
<td>Supporting Body Weight</td>
<td>20m</td>
<td>O</td>
<td></td>
<td></td>
<td>Ascending/Descending Bulldozer via steps, stairs and ladders 5-6 times/shift. (dock – steps only; ship – all)</td>
</tr>
<tr>
<td>Gripping / Handling</td>
<td>&lt;1m</td>
<td>F/C</td>
<td></td>
<td></td>
<td>Joysticks &amp; other controls: repetitive small movements.</td>
</tr>
<tr>
<td>Fine Motor Skills</td>
<td>&lt;10s</td>
<td>F/C</td>
<td></td>
<td></td>
<td>Complex small movements of joystick control to operate articulating arm and attachment.</td>
</tr>
<tr>
<td>Sitting</td>
<td>5.33</td>
<td>F/C</td>
<td></td>
<td></td>
<td>Constant sitting for duration of work (4-5.33 hrs)</td>
</tr>
<tr>
<td>Driving</td>
<td>5.33</td>
<td>F/C</td>
<td></td>
<td></td>
<td>Continuous – 2hr40min without break; Normal – 2hr</td>
</tr>
<tr>
<td>Standing</td>
<td>&lt;5m</td>
<td>O</td>
<td></td>
<td></td>
<td>During visual inspection.</td>
</tr>
<tr>
<td>Walking</td>
<td>100m</td>
<td>O</td>
<td></td>
<td></td>
<td>Walk from machine, up gangway to vessel, through passageways and down ladders, stairs to access hold. May be repeated 2-6X per shift.</td>
</tr>
<tr>
<td>Bending/ Stooping</td>
<td>&lt;30s</td>
<td>R</td>
<td></td>
<td></td>
<td>During visual inspection.</td>
</tr>
<tr>
<td>Sustained Crouching/ Kneeling</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climbing Stairs</td>
<td>5m</td>
<td>R</td>
<td></td>
<td></td>
<td>Go up/down ladders and stairs to access/exit hold.</td>
</tr>
<tr>
<td>Climbing Ladders</td>
<td>&lt;1m</td>
<td>R</td>
<td></td>
<td></td>
<td>Go up/down ladders and stairs to access/exit hold.</td>
</tr>
<tr>
<td>Crawling</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balancing</td>
<td>&lt;5m</td>
<td>R</td>
<td></td>
<td></td>
<td>When climbing onto Bulldozer inside hold; walking over bulk product in hull (loose surface).</td>
</tr>
<tr>
<td>Throwing</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhead Reach</td>
<td>&lt;5s</td>
<td>R</td>
<td></td>
<td></td>
<td>Climbing ladders when ascending/descending.</td>
</tr>
<tr>
<td>Exposure to Elements</td>
<td>&lt;5m</td>
<td>O</td>
<td></td>
<td></td>
<td>Ascending/descending Bulldozer or during visual inspection.</td>
</tr>
<tr>
<td>Uneven Surfaces</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td>When accessing Bulldozer inside vessel.</td>
</tr>
<tr>
<td>Proximity to moving objects</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td>Not within the cab, outside there may be other heavy equipment operating in area (bulldozers, overhead cranes, and excavator).</td>
</tr>
<tr>
<td>Vibration (upper extremity)</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration (whole body)</td>
<td>5.33/7.5h</td>
<td>F/C</td>
<td></td>
<td></td>
<td>Constant low level vibration when operating Bulldozer.</td>
</tr>
</tbody>
</table>

**Frequency Ratings:**

N: Never  
R: Rare - Not daily or up to 1% of shift (<5mins/day)  
O: Occasional - 1%-33% of shift (up to 2.5hrs)  
F: Frequent - 34%-67% of shift (2.5-5hrs)  
C: Constant - >67% of shift (>5hrs)