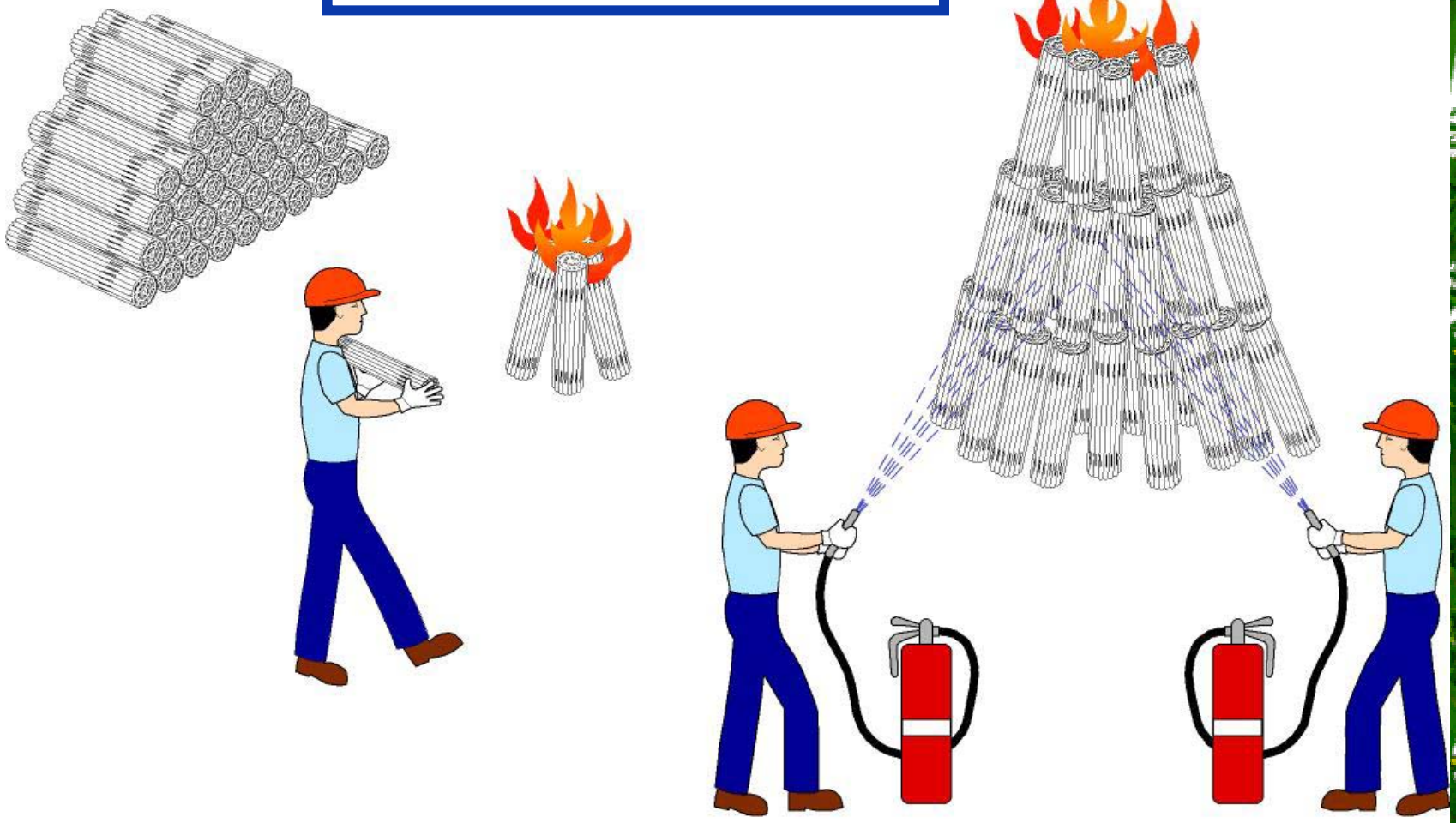
Fuel and Fuelling

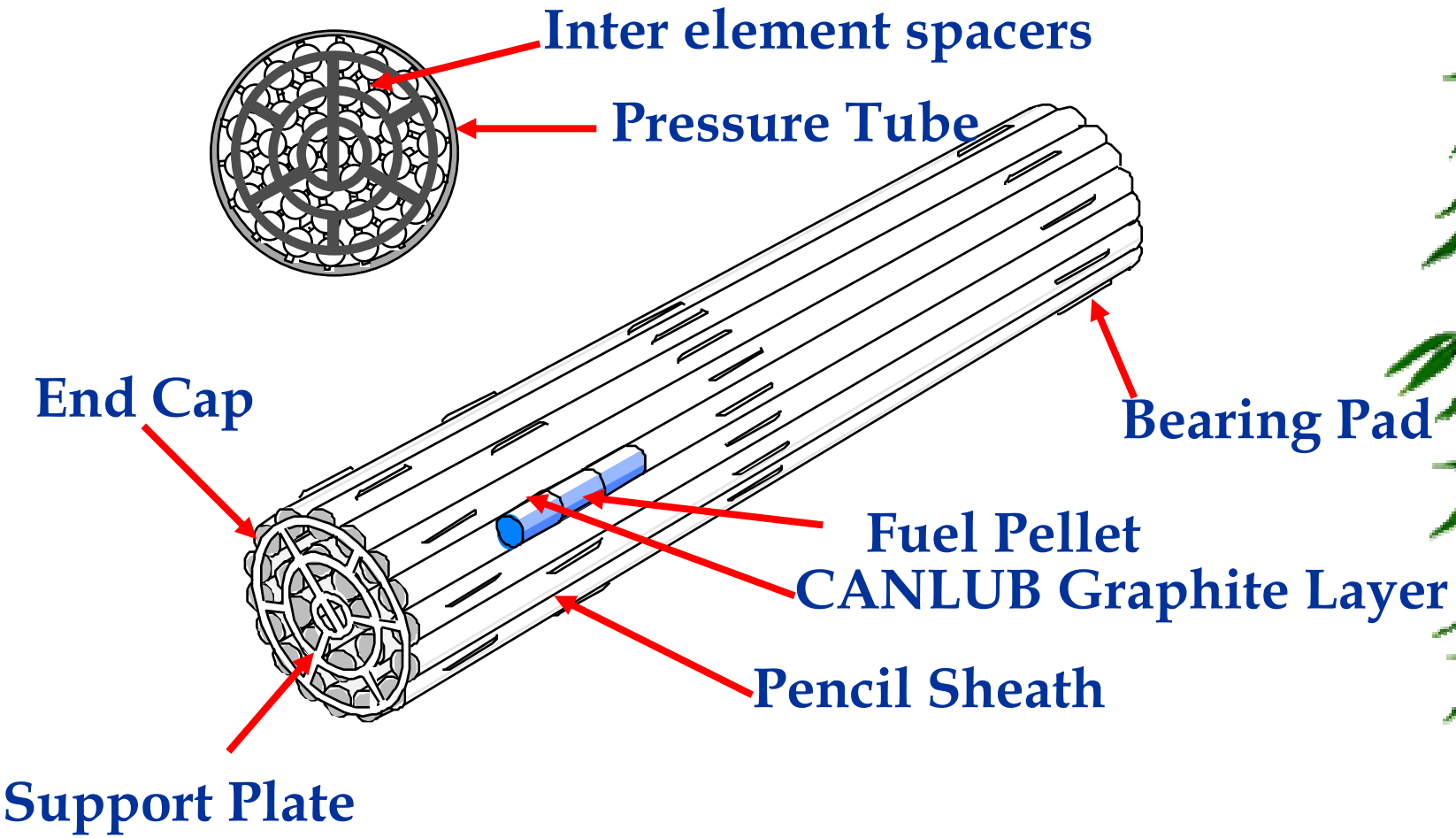
On Power Fuelling

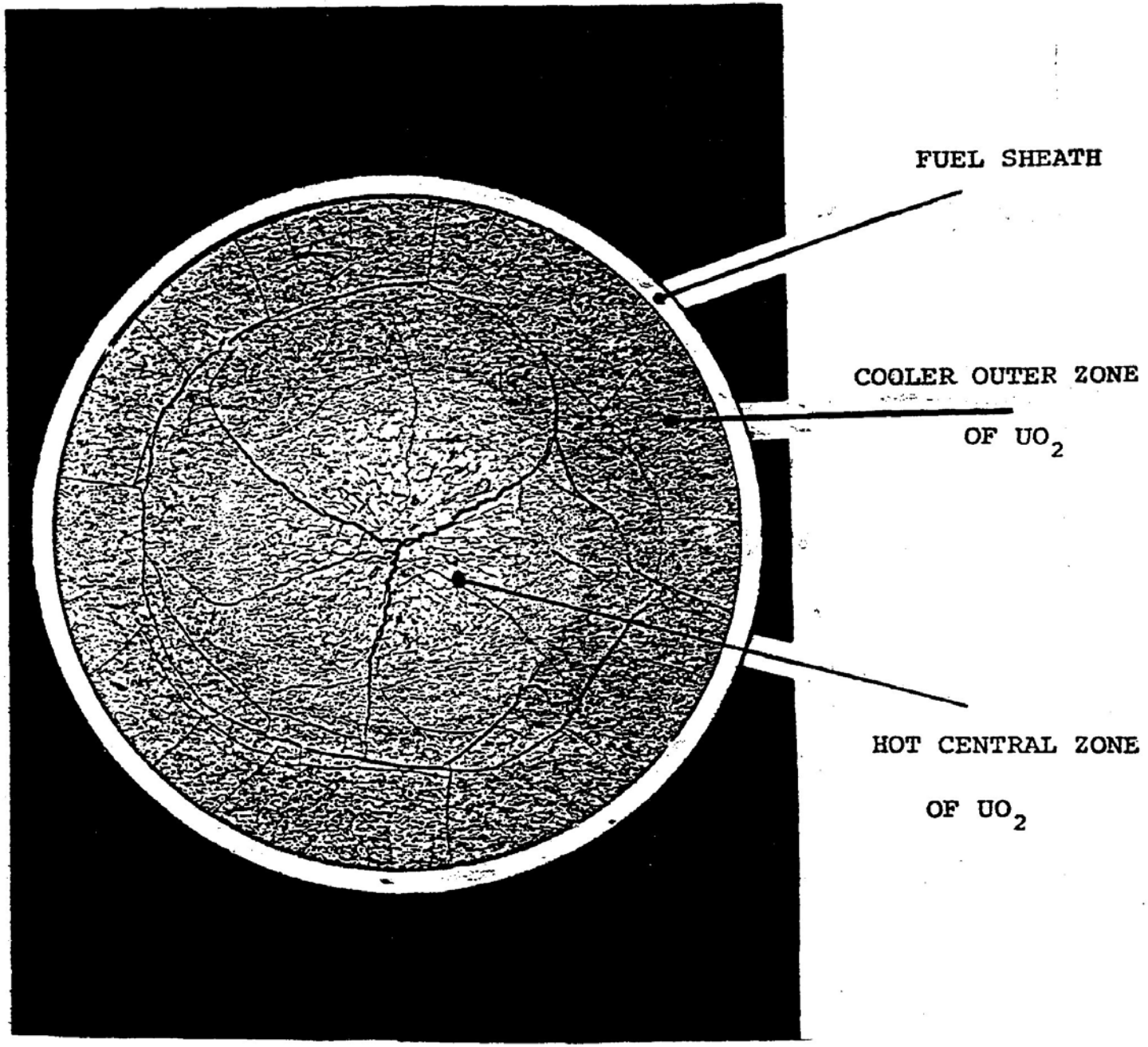


CANDU
Fuel added as needed

LWR
18 months fuel added at once.
Burning rate suppressed

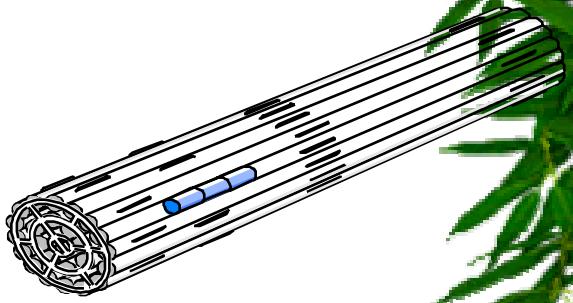
Fuel


Inter element spacers
Pressure Tube
End Cap
Bearing Pad
Fuel Pellet
CANLUB Graphite Layer
Pencil Sheath
Support Plate


FUEL SHEATH
COOLER OUTER ZONE
OF UO_2
HOT CENTRAL ZONE
OF UO_2

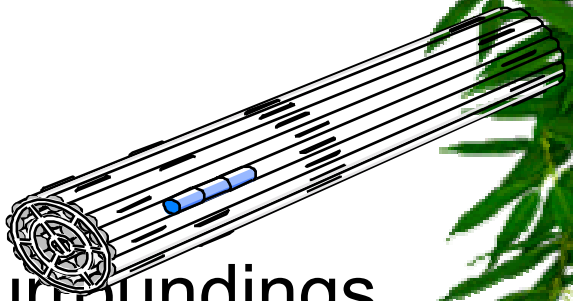
Fuel Bundles

- 18.8 kg of uranium (40 lbs)
- Assembled in He atmosphere
- Natural uranium U2O
- Depleted Fuel 0.4%
  - fresh core
  - if defective fuel is removed
- Long Bundles
  - help make up for channel growth
  - temporary measure
- 12 -18 bundles/reactor FP day
- Irradiated
  - always under water except during transfer from the machines to the bay



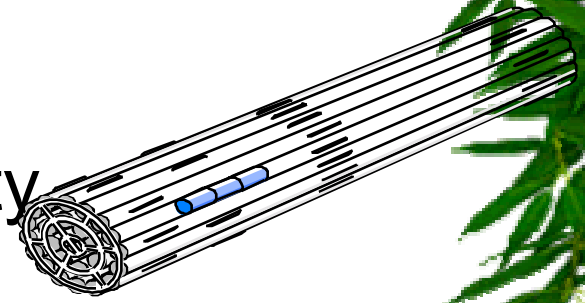
Characteristics of Fissile Material

- High fissile content
- Efficient heat transfer
- Fission product containment
- Chemical compatibility with surroundings
- High melting temperature
- Stability in core
- Ease of fabrication and cost



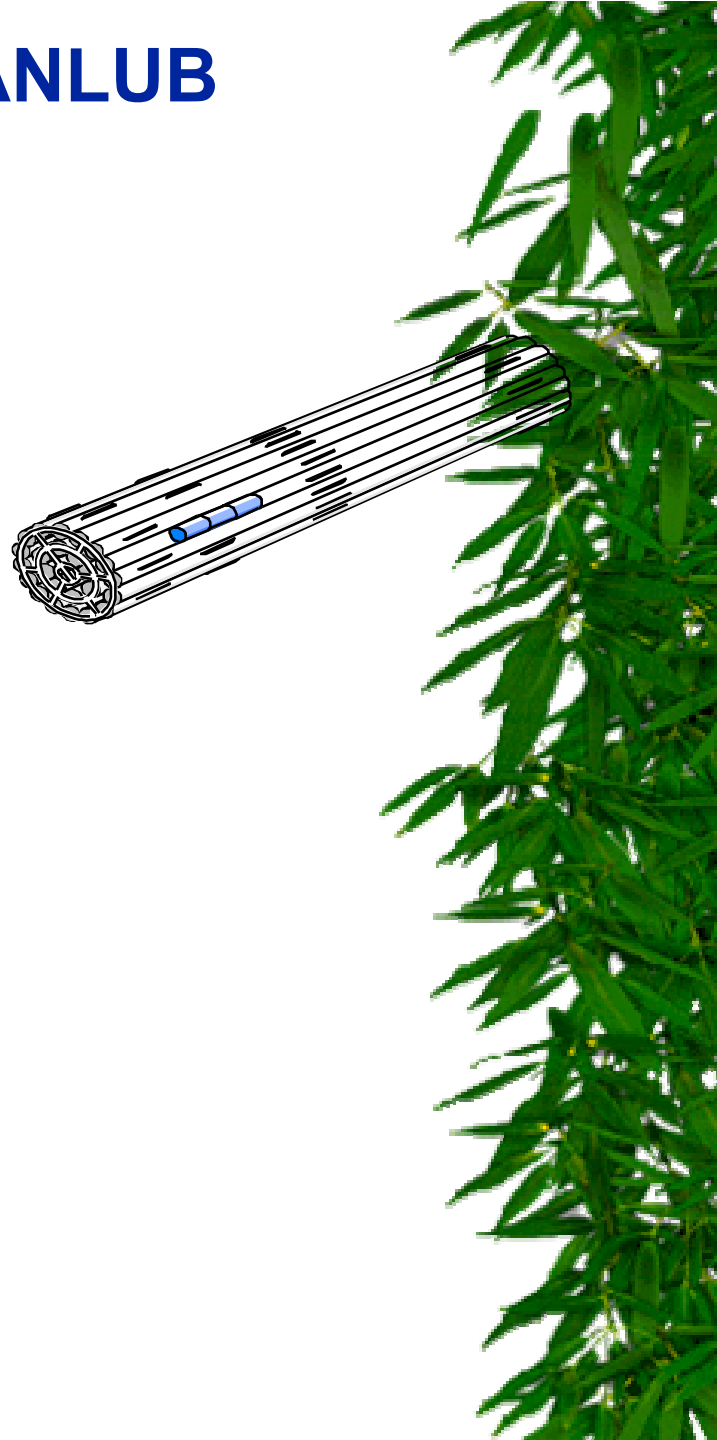
Characteristics of Fuel Sheath

- Low neutron absorption
- Mechanical strength
- Adequate thermal conductivity
- Chemical compatibility



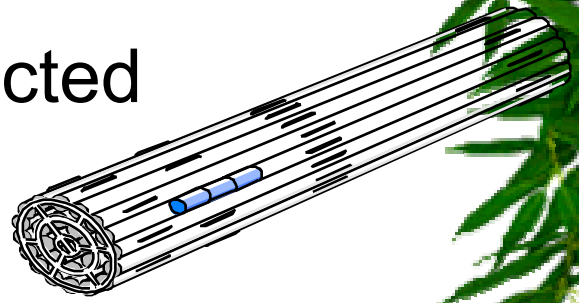
Three Good Things About CANLUB

- Lubrication
- Thermal conductivity
- Prevent chemical attack

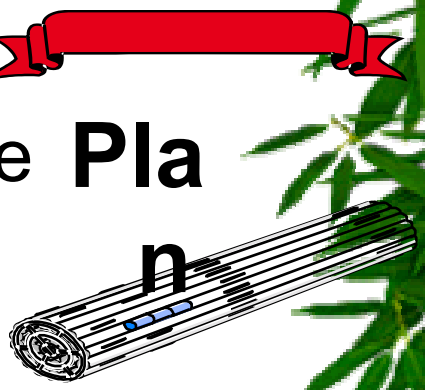


New Fuel

- Stored in original containers before use
- Unpacked by hand and inspected
- Time in cross flow limited
- Dimension check
- Clean off any dirt
- Bundles get the white glove treatment



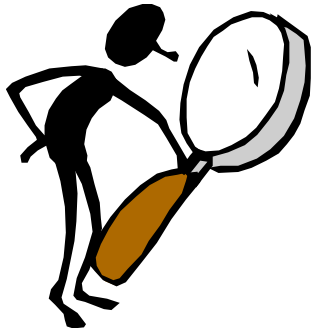
Fueling Strategy

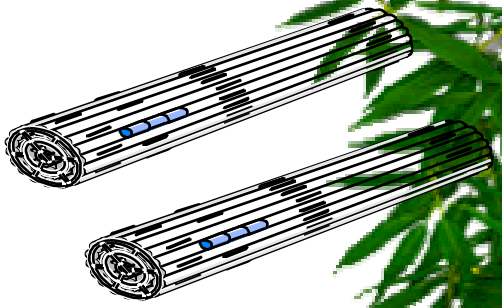


- Computer Program simulates core
  - axial and radial power distributions
  - burnup of each bundle
  - excess reactivity
- Remove defective fuel
- Keep zones near mid range
- Keep flux flat (all zones near average)
- Minimize fueling ripple
- Replace high burn-up fuel
- Don’t expose high burn-up fuel to large power ramps or high flux

Fuelling Sequence

- Fuelling machine is connected to new fuel port
- Fuel is inspected
  - serial numbers
  - spacers
  - gauged





- Fuel put into loading mechanism 2 bundles at a time
- Fuel is loaded automatically loaded into machine
- Machine is moved to reactor face
- Machine is attached to channel
- Heads are pressurized

Fuelling Sequence

- Leak Check
- Remove and store closure plug
- Remove and store shield plug
- One machine pushes in 2 bundles with the flow
- Other machine accepts two bundles
- Process is repeated 2 or 4 times
- Shield plugs are reinstalled
- Closure plugs are reinstalled
- Leak test
- Fuel other channels

Fuelling Sequence

- Machine moved to spent fuel bay
- Connected to spent fuel port
- Two bundles pushed onto elevator in chamber
- Bundles lower into tray
- Tray stored in primary bay
- Moved after at least 6 months to the secondary bay

Irradiated Fuel

- Water cooling
- Handled remotely and shielded
- Handled in trays

Failed Fuel

- Raises doses rates
- Increases risk to public
- Makes more failed fuel harder to detect

Depleted Fuel

- 0.4% - 0.5% natural uranium
- Placed to flatten flux
- Freshly fuelled reactor
- After removal of failed fuel