

# Update on C-14 Sampling at V. C. Summer Nuclear Station.



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# C-14 Sampling at VC Summer Station.

- Working with GEL Laboratories, we conducted a pilot program in 2010. The results of these samples were reported at the 2010 RETS-REMP Workshop.
- During our recent refueling outage, we collected additional samples to determine the impact of core life and outage activities .

# Sample Points

- Main Plant Vent – effluent monitor
- Reactor Building – process monitor & RB Purge
- Waste Gas System

# Main Plan Vent Results

## Beginning of Core Life

- Total C-14 =  $1.39\text{E-}09$  uCi/ml.
- C-14 as  $\text{CO}_2$  = < MDA of  $3.78\text{E-}11$  uCi/ml.

## End of Core Life

- Total C-14 =  $2.87\text{E-}09$  uCi/ml.
- C-14 as  $\text{CO}_2$  = < MDA of  $6.20\text{E-}11$  uCi/ml.

# Reactor Building Results

## Beginning of Core Life

- Total C-14 =  $7.32\text{E-}07$  uCi/ml.
- C-14 as  $\text{CO}_2$  =  $4.65\text{E-}08$  uCi/ml.

## End of Core Life

- Total C-14 =  $3.12\text{E-}06$  uCi/ml.
- C-14 as  $\text{CO}_2$  =  $1.55\text{E-}07$  uCi/ml.

$\text{CO}_2$  accounts for  $\sim 5\text{-}6\%$  of C-14.

# Waste Gas Results

- Total C-14 =  $5.11\text{E-}03$  uCi/ml.
- C-14 as  $\text{CO}_2$  =  $3.02\text{E-}04$  uCi/ml.
- $\text{CO}_2$  accounts for  $\sim 6\%$  of C-14.

# Outage Impact – Main Plant Vent

## End of Core Life

- Total C-14 =  $2.87\text{E-}09$  uCi/ml.
- C-14 as  $\text{CO}_2$  = < MDA of  $6.20\text{E-}11$  uCi/ml.

## Refueling Cavity Flood Up Following Reactor Head Lift

- Total C-14 =  $6.02\text{-}10$  uCi/ml.
- C-14 as  $\text{CO}_2$  =  $4.10\text{E-}10$  uCi/ml.
- **$\text{CO}_2$  accounts for 68% of C-14.**

# Outage Impact – RB Purge

## Reactor Head Removal

- Total C-14 =  $1.16\text{E-}08$  uCi/ml.
- C-14 as  $\text{CO}_2$  =  $6.11\text{E-}09$  uCi/ml.
- **$\text{CO}_2$  accounts for 53% of C-14.**

## Core Off Loaded – Flood Up from Mid-loop.

- Total C-14 =  $9.30\text{E-}09$  uCi/ml.
- C-14 as  $\text{CO}_2$  =  $3.77\text{E-}10$  uCi/ml.
- **$\text{CO}_2$  accounts for 4% of C-14.**



# Outage Impact – RB Purge

## Reactor Core Reload

- Total C-14 = 2.69E-09 uCi/ml.
- C-14 as CO<sub>2</sub> = 1.50E-09 uCi/ml.
- **CO<sub>2</sub> accounts for 56% of C-14.**

# RCS Clean Up– Impact on C-14?

Single Carbon Atom Species		Environment
CO <sub>2</sub>	Carbon Dioxide	Oxidizing
CO	Carbon Monoxide	↓
HCOOH	Formic Acid	
H <sub>2</sub> C=O	Formaldehyde	
CH <sub>3</sub> OH	Methanol	
CH <sub>4</sub>	Methane	Reducing

# Conclusions

- C-14 levels do increase over core life.
- H<sub>2</sub>O<sub>2</sub> addition and/or open of systems does impact the chemical form of C-14.