

2-0



Tritium Production and Release Path

Braidwood Operations Training

Original Developed by: Dan Redden
Tom Ross
Exelon Nuclear Fuels

Information in this record was deleted in
accordance with the Freedom of Information Act.
Exemptions 4
FOIA PA 2010-0275

B-7

• Tritium Basics



- Unstable isotope of Hydrogen
- Nucleus (triton): 1 proton & 2 neutrons
- Readily incorporates into water
- Decays via a weak beta (6 KeV)
with a 12.3 year half life

OPS Fundamentals

Solid Understanding of Plant Design and System Interactions

Learn the Fundamentals

Tritium Basics

Why the concern over Tritium?

The city of Wilmington draws their drinking water from the Kankakee. Exelon and the Illinois Emergency Management Agency (IEMA) provide sampling equipment to ensure that Tritium limits are not exceeded.

Property along the "Lake Blowdown" pipe contaminated with tritium from spurious operation of "Vacuum Breakers"

Cross contamination of normally "Clean" systems at Braidwood resulting in groundwater tritium on our property

Tritium Basics (Cont'd)



Manmade Generation:

- Nuclear Weapons Testing
 - Primarily in 1950's & 60's
 - After 35+ years decay, 5x natural tritium still in environment
 - Expected to return to natural levels by 2030
- Tritium Production Reactors
 - US large scale production ended at Savannah River in 1988
 - New production at Watts Bar using lithium loaded Fuel rods
- Nuclear Power Reactors
 - Over 90% of tritium generated is trapped within fuel & BP rods

Key Nuclear Reactions Producing Tritium



- Ternary Fission

- 1 / 10,000 fissions
- Dominant production mechanism in nuclear power reactors
- Most tritium chemically “trapped” in UO_2 pellet matrix

- ^{10}B Related Production

- Soluble boron (tritium produced directly in coolant)
- IFBA (ZrB_2) coated fuel pellets (tritium produced inside fuel rod)
- WABA discrete BPs (tritium produced inside WABA rod)
- Tritium production reaction: $^{10}\text{B} + ^1_0\text{n} \rightarrow 2\ ^4_2\text{He} + ^3_1\text{H}$
 - Fast neutron, 0.04 barn
- Lithium production reaction: $^{10}\text{B} + ^1_0\text{n} \rightarrow ^7_3\text{Li} + ^4_2\text{He}$
 - Thermal neutron, 3800 barn

Key Nuclear Reactions Producing Tritium (cont'd)

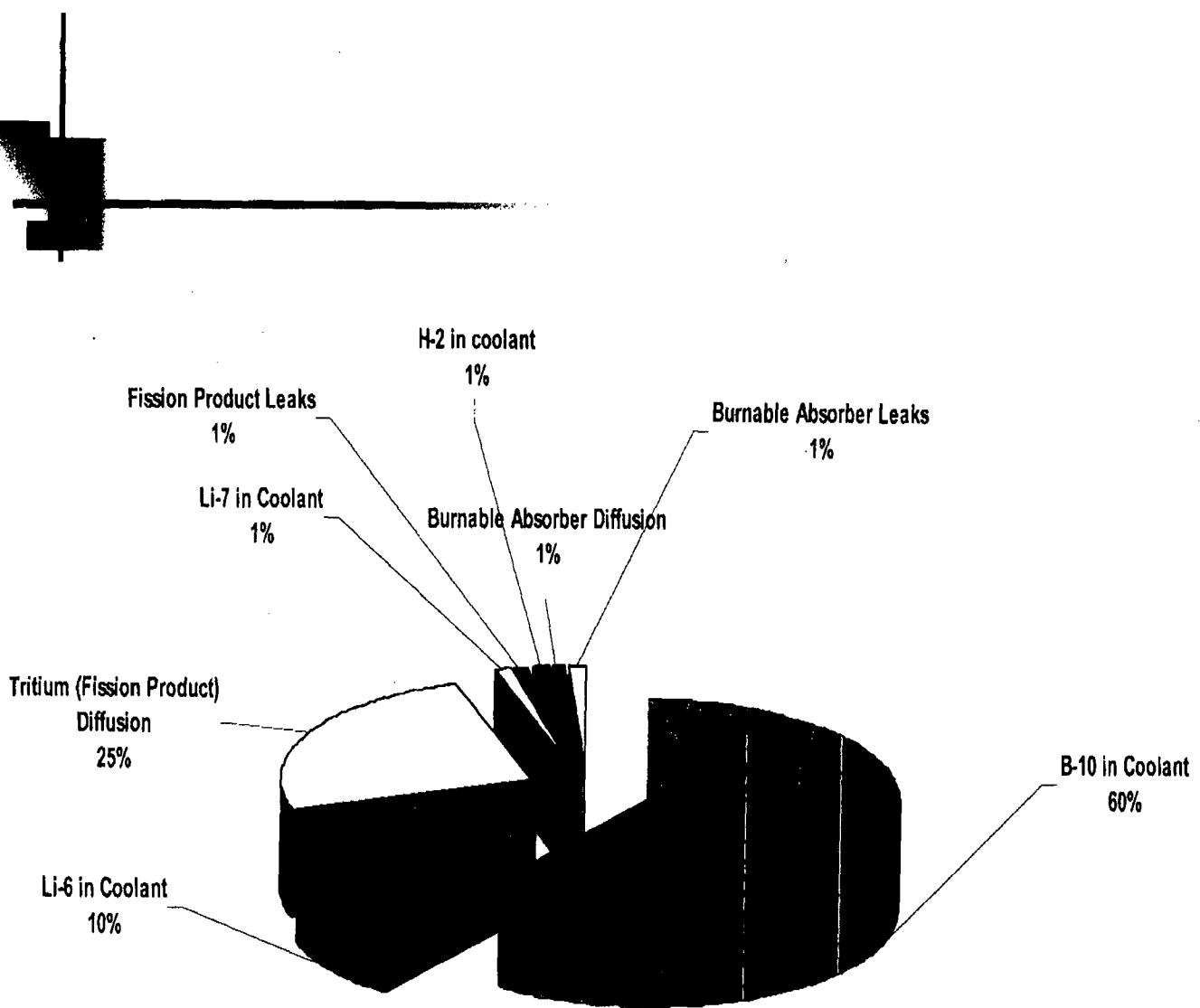
• Lithium Related Production

- Lithium (99.95% ${}^7\text{Li}$) added at BOC, reduced thereafter
- ${}^7\text{Li}$ generated from ${}^{10}\text{B}$ in coolant, IFBA, & WABA
- ${}^7\text{Li} + {}^1_0\text{n} \rightarrow {}^1_0\text{n} + {}^4_2\text{He} + {}^3_1\text{H}$
 - Fast neutron, 0.33 barn
- ${}^6\text{Li} + {}^1_0\text{n} \rightarrow {}^4_2\text{He} + {}^3_1\text{H}$
 - Thermal neutron, 940 barn
 - ${}^6\text{Li}$ suspected to deplete rapidly (neut reaction + demin removal)

• Other Minor Production

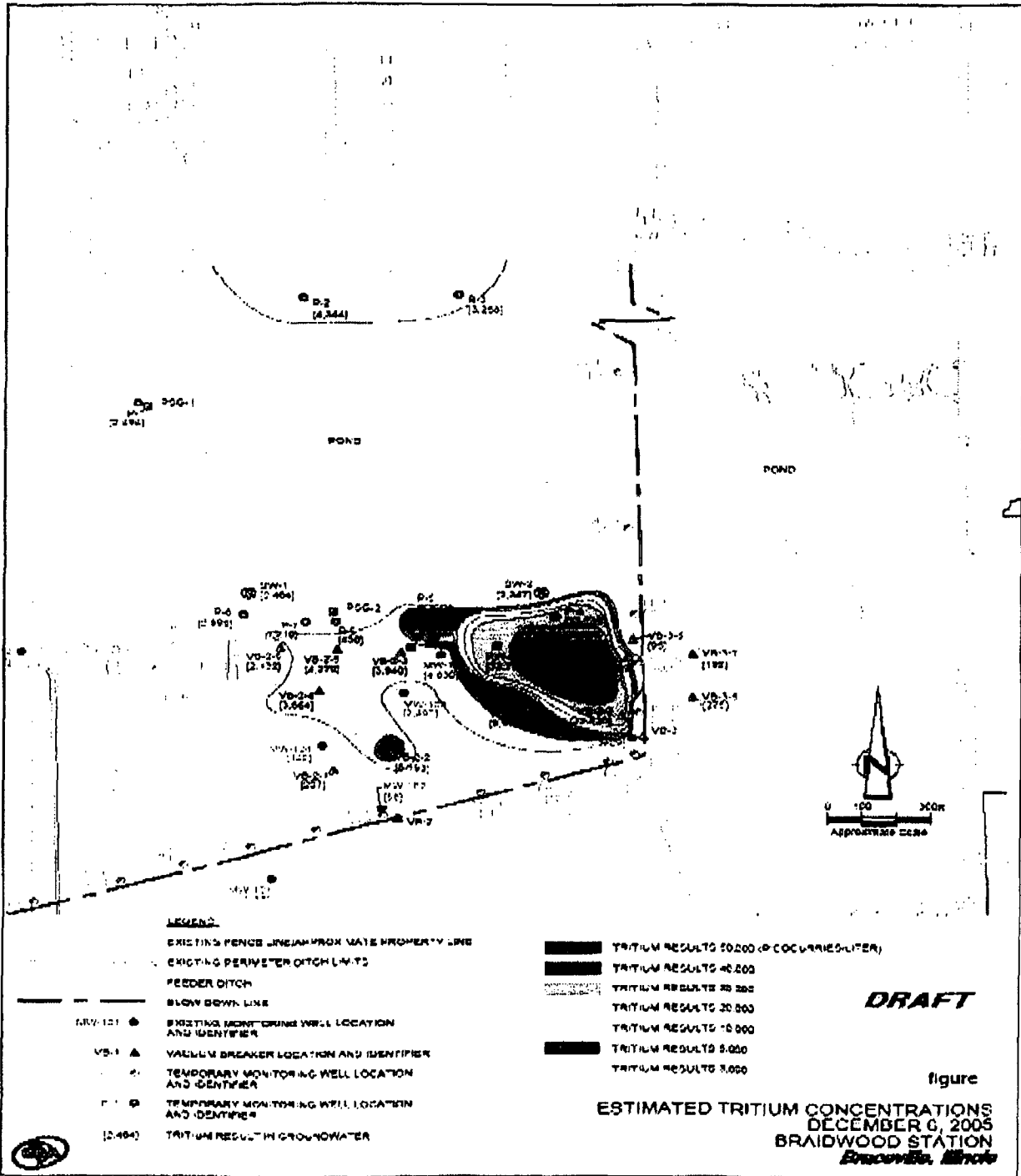
- ${}^2_1\text{H} + {}^1_0\text{n} \rightarrow {}^3_1\text{H}$
 - Thermal neutron, 0.0005 barn
- ${}^{11}\text{B}$ & ${}^{14}\text{N}$ (negligible production)

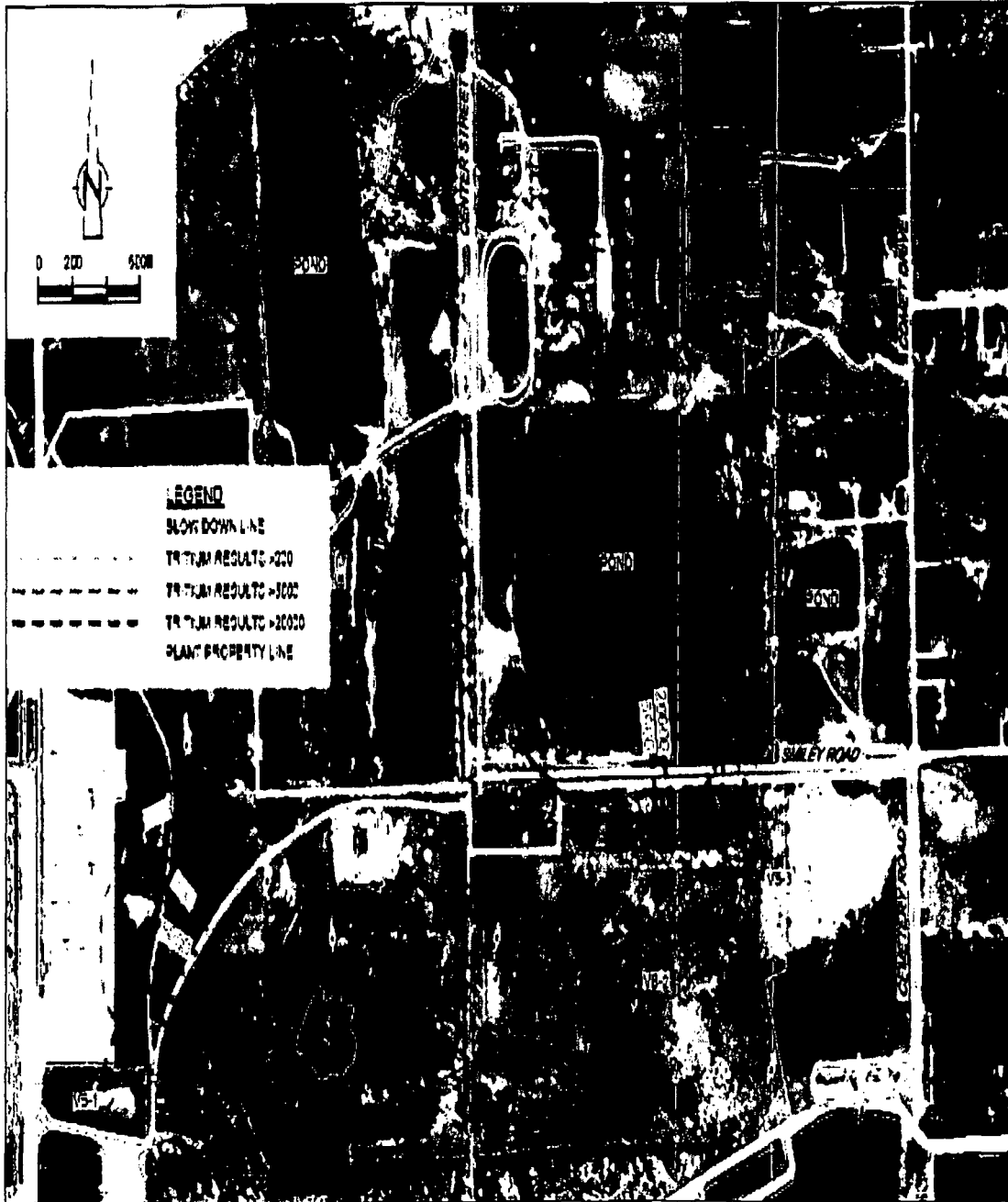
Where Does Tritium Come From?

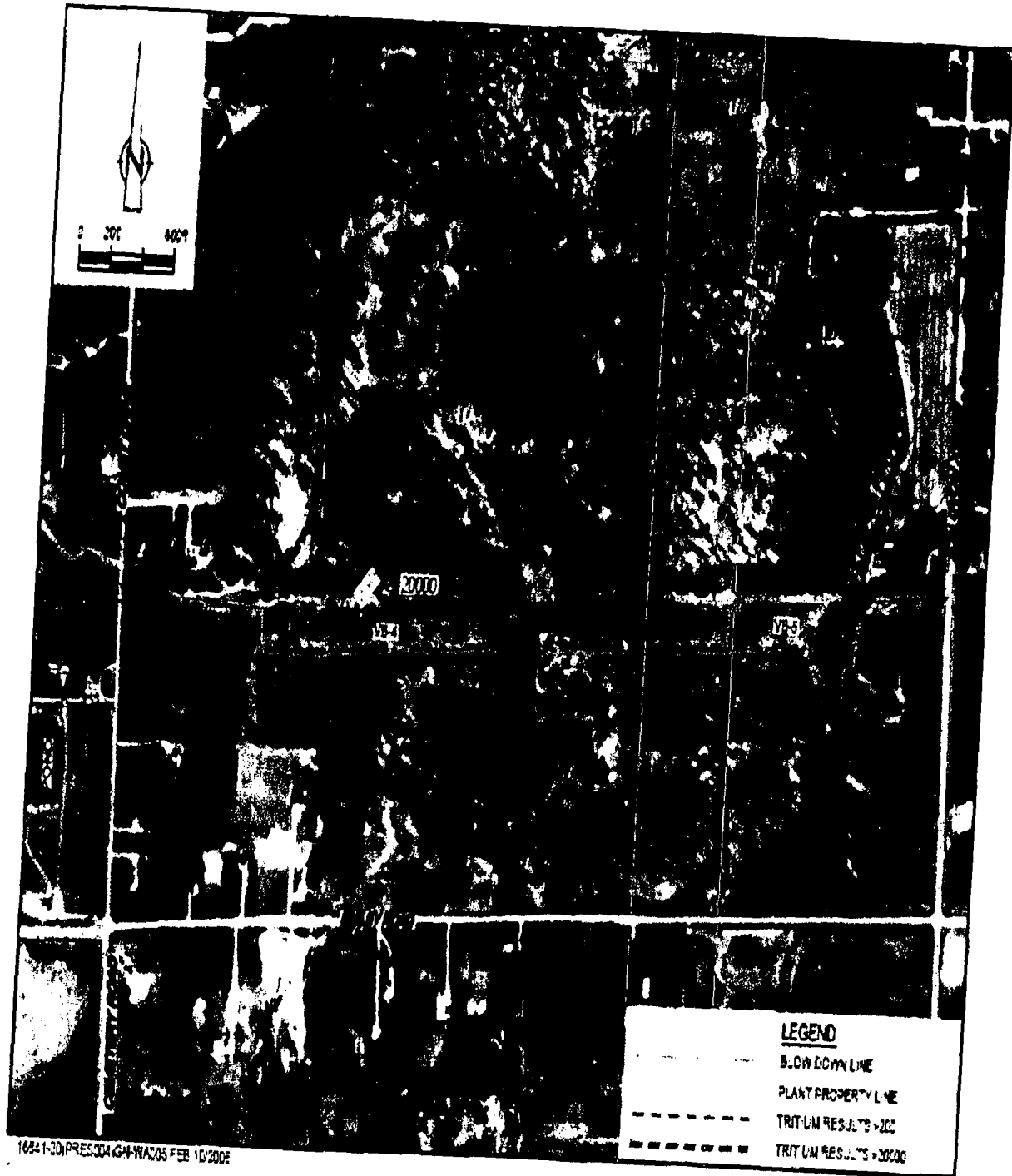


Braidwood Blowdown Line – Vacuum Breakers











162401PFE004 04-14-03 PEE 10000

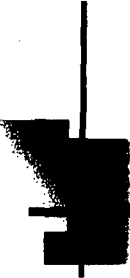
Actions – Braidwood Recycle Team

Short Term (starting immediately through the next 1 – 3 years):

- Release tank liquid discharges were suspended at Braidwood Station
- Team develop methods to allow continued operation with zero liquid release from release tanks
- Water management
 - Reduce inputs to radwaste
 - Deborate using resin when RCS boron \leq 200 ppm
 - Water management and effective use of installed demineralizers
 - Outage water management (e.g. loop fill source)

Long Term:

- Operate the plant as designed (recycle primary water)



EC 359099

- This EC will:
 - Modify the RWMT inlet piping to segregate water sent to vendor processing from that water received from the ALPS system.
 - Also segregates water sent to ALPS from that sent to the release tanks, CSTs, PWSTs and SG Blowdown

