

# Oklahoma Gas & Electric Underground Cable Failure Data Base and Failure Rates

by

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Oklahoma Gas and Electric Co.

Presented at the  
IEEE/ICC Education Program "Statistical  
Analysis of URD Cable Failures"

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# OG&E UG Cable Distribution System?

- A. 60,000 Segments of Underground Primary Cable. Present Growth approx. 3.5 to 4%
- A **Segment** is that length of Cable that connects two devices
    - Riser disconnect to a transformer,
    - Transformer to transformer, or
    - Transformer to switch cubicle, etc.)
    - Average segment Length approximately 450 to 500 ft.
- B. URD Cable, 35kV(**1984** -Present): 430 Miles
- Average of **1.88 failures/100 miles/year**
  - This URD cable will not be included in remaining presentation.

# OG&E UG Cable Distribution System?

(Continued)

## C. URD Cable, 15kV

- 2/C-#2AL(Bare Conc. Neut.) : **1504** miles  
(1970 to 1983/1984)
- 2/C-#2AL(Conc. Neut. Jkt) : **528** miles  
(1984 to Present)
- 2/C-#0AL(Bare Conc. Neut.) : **398** miles  
(1970 to 1983/1984)
- 2/C-#0AL(Conc. Neut. Jkt) : **113** miles  
(1984 to Present)
- 2/C-#4CU & Others (Late 1960's)\* : **42** miles

\*Not included in remainder of presentation.

B. Feeders and other Large cables at 15, 24, and 35kV will not be presented. Insufficient Data.

C. Accessories and other types of failures not included in this presentation.

# Why Collect Data on Cable Failures

- A. Allows Engineering to assess failure data coming from the field in order to change or correct materials, construction standards and/or practices.
- B. Crews use decision-making tools that are driven by the database (i.e. loop trace in FACTS).
- C. Information collected from the field is used to correct data information in GEMS and other Databases.

# Brief Overview of the OG&E Database: Failed Accessories and Cable Tracking System

- FACTS is driven by the OG&E Graphical Database (Oracle database). **On-line yr2000**
- Data is collected from crews through reports (TD-99's).
- Reports are entered daily.
- The real-time database can be interrogated by Crews to assess URD cables through "Trace Tools".
- Engineering can investigate both databases:
  - Real-time (**2697 records from year 1999 to present**)
  - Historical (**3776 records dating back to 1992**)

# Analysis of 15kV URD Cable Failures

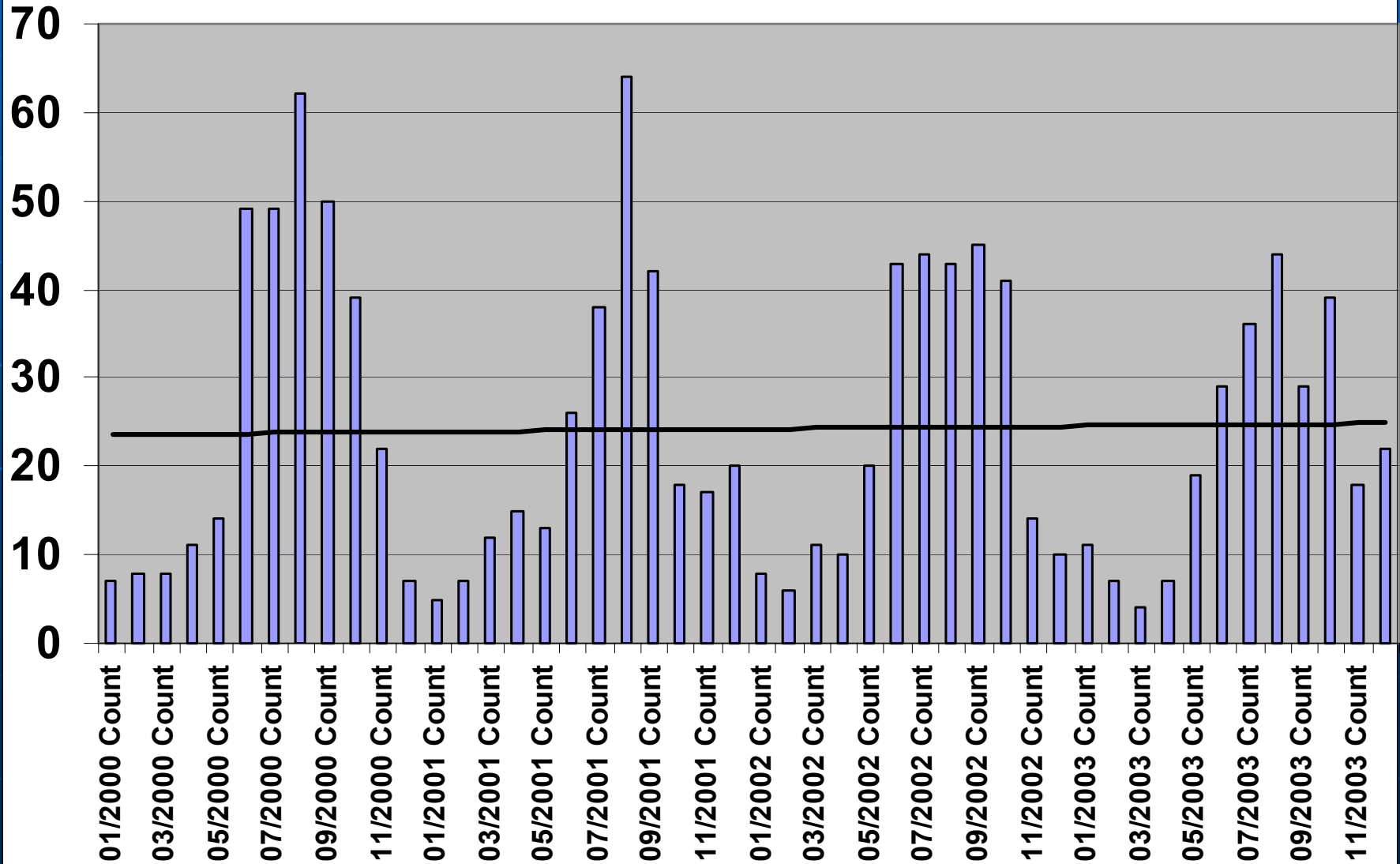
Note: Data Collected by the Real-time Database

## URD Cable, 15kV (Average for Years 2000 thru 2003)

- 2/C-#2AL (Bare Conc. Neut.) (1970 to 1983/1984)  
: **1504** miles, **19.28** failures/100 miles/Yr
  - 2/C-#2AL (Conc. Neut. Jkt) (1984 to Present)  
: **528** miles, **2.28** failures/100 miles/Yr
  - 2/C-#0AL (Bare Conc. Neut.) (1970 to 1983/1984)  
: **398** miles, **14.35** failures/100 miles/Yr
  - 2/C-#0AL (Conc. Neut. Jkt) (1984 to Present)  
: **113** miles, **7.97** failures/100miles/Yr
  - \*Average U.S. Failure rate as reported in 1994  
: 48 utilities, **6.2** failures/100miles/Yr
- \*"Cable Restoration and Replacement Practices in the U.S." presented by Richard L. Harp to the EEI T&D Meeting, Salt Lake City, Utah in October, 1994

# Analysis of 15kV URD Cable Failures

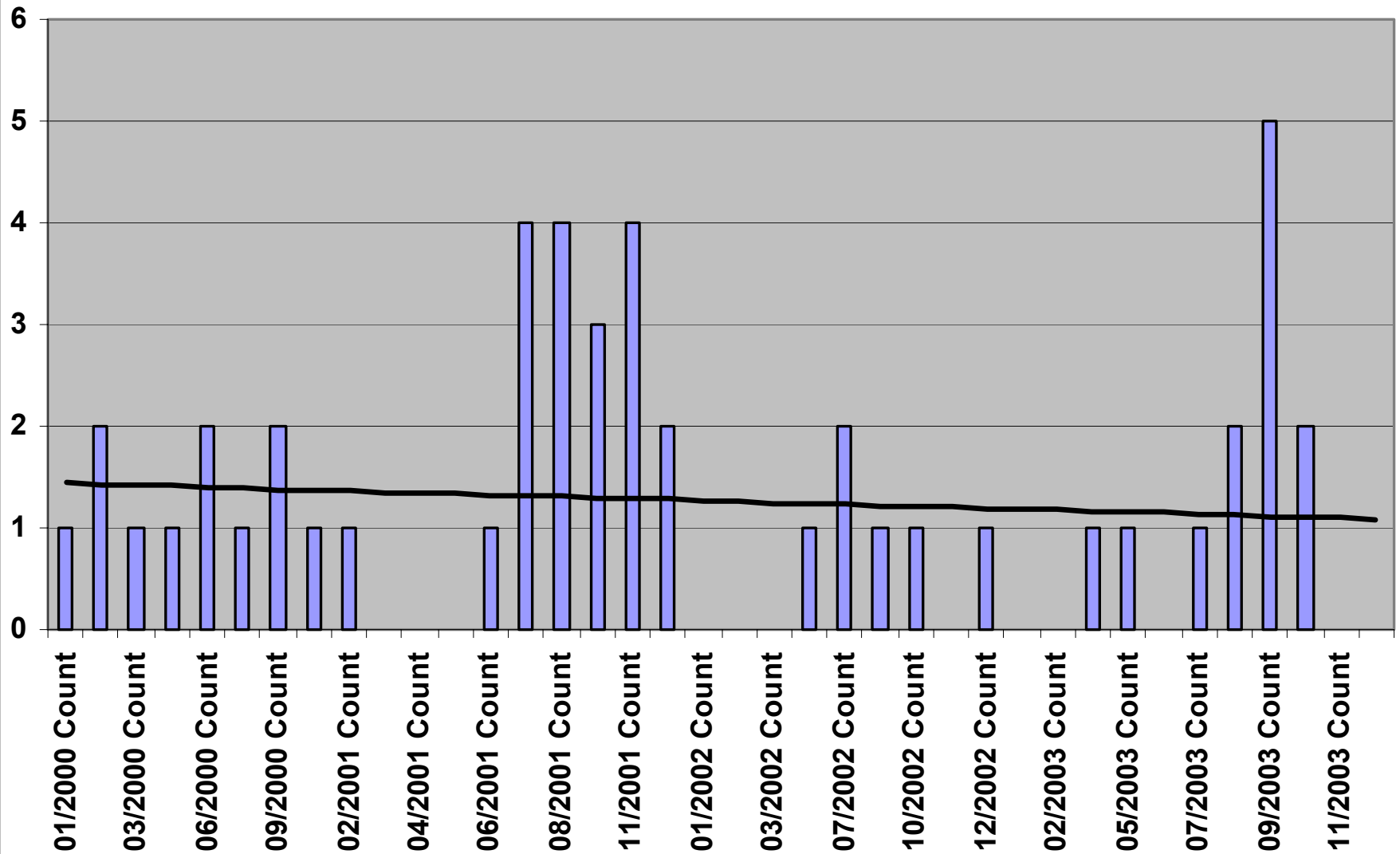
**2/C #2 Solid AL(1970 to 1984), 15kV, Bare Concentric Neutral Failures per Month**





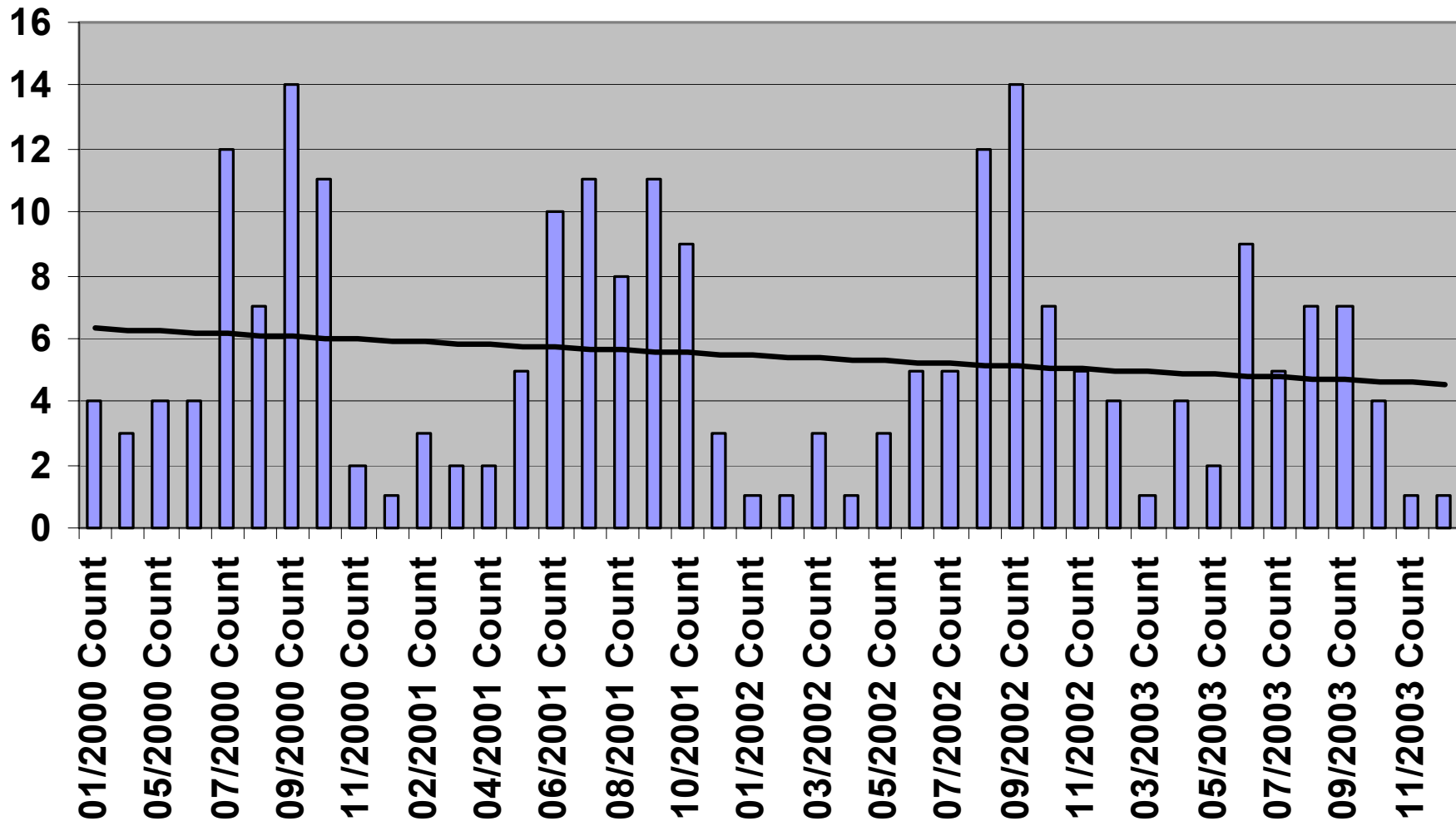
# Analysis of 15kV URD Cable Failures

**2/C #2 Solid AL, 15kV, Concentric Neutral, Jacketed  
(1984 to Present) Failures per Month**



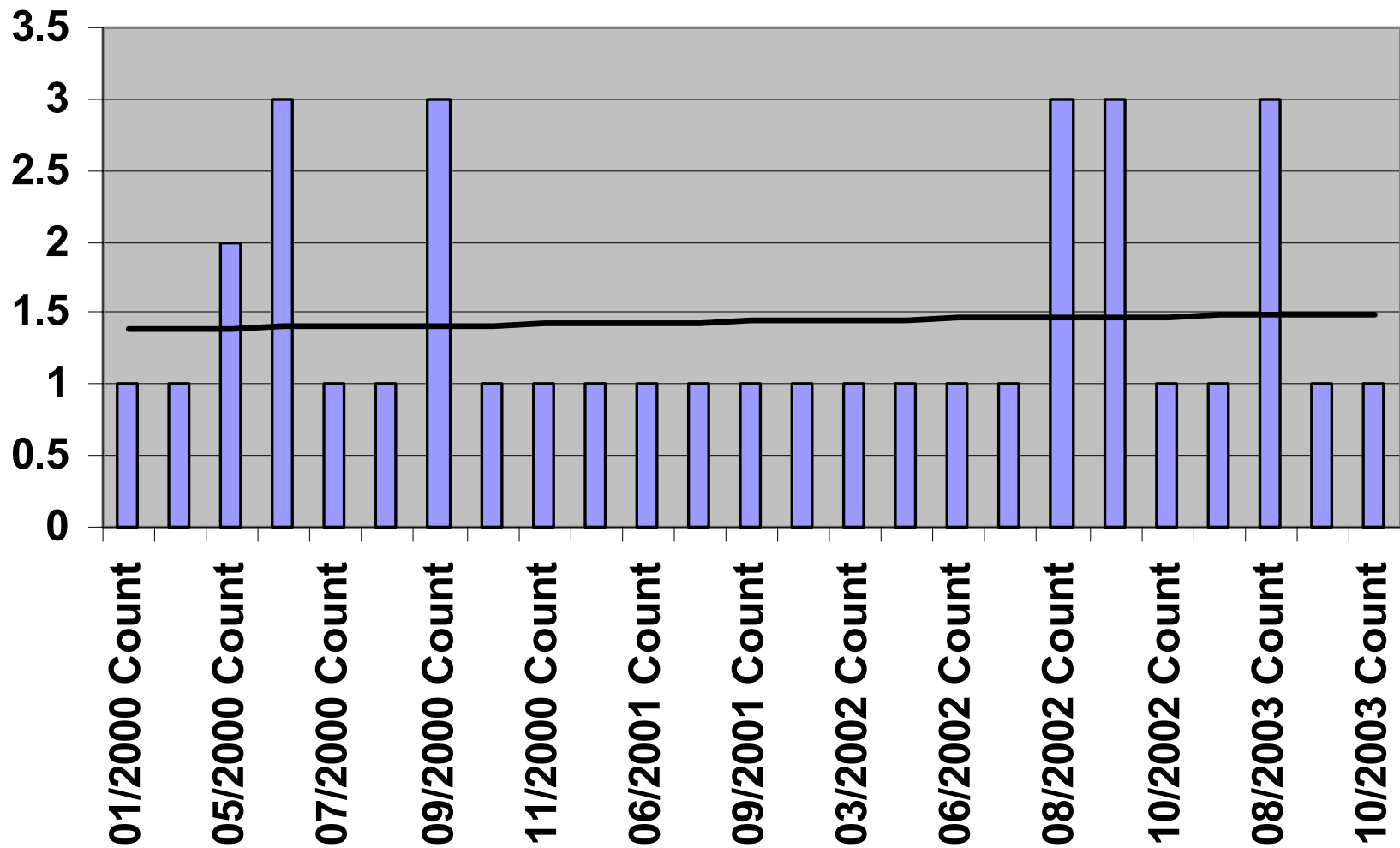
# Analysis of 15kV URD Cable Failures

**2/C #0 Solid AL, 15kV, Bare Concentric Neutral (Yr. Manuf 1970 to 1984) Failures per Month**



# Analysis of 15kV URD Cable Failures

**2/C #0 Solid AL, 15kV, Concentric Neutral, Jacketed Cable, (Yr of Mfg 1984 to Present) Failures Per Month**



# GEMS View “FACTS” as a Decision Tool (for Crews and Engineering)

- Allows crews or engineering to investigate every UG segment in the OG&E system.
- Before 1997,
  - Crews were to replace URD half-loops that had more than 2 failures and;
  - the complete loop if more than three failures.
- 1997 to 1999,
  - Crews were to replace segments where the 2<sup>nd</sup> failure occurred within 12 months of the 1<sup>st</sup> failure.
- 2000 to present,
  - Crews were to replace segments where the 2<sup>nd</sup> failure occurred within 12 months of the 1<sup>st</sup> failure.
  - And a half-loop or whole loop replacement depending on the trace in “FACTS” of the loop when the 2<sup>nd</sup> failure occurs.

# GEMS View "FACTS" as a Decision Tool

The screenshot displays the GEMS View software interface. The title bar reads "Field View - gydAll - [Geographic View 1]". The menu bar includes "Packet", "Edit", "View", "Query", "Tools", "Redlines", "Options", "Custom", "Admin", "Window", and "Help". The toolbar contains various icons for file operations, navigation, and analysis. The main window shows a detailed cable network map with streets such as BLUE SAGE CT, MEADOW RIDGE RD, HUNTER HILL RD, WAKEFIELD CT, HUNTSWOOD RD, THISTLEWOOD DR, LAURELLE DR, PARKSIDE PL, and BENTBROOK DR. The map features numerous nodes, lines, and labels, including "NO" (North Ori) and "NO" (South Ori) points. Two text annotations in orange are overlaid on the map:

- Construction should develop a job / jobs. Note the numerous failures when a "Trace" is performed on the half loop from the NO point to the North Riser.**
- The other half loop is not much better to the south riser and should be replaced as all cable is 1971-1973 vintage.**

The status bar at the bottom shows "Select Command", "X: -29841435 Y: -1062232202 Zoom: 2654", and "Zoom In/Window Area". The Windows taskbar is visible at the very bottom.

# GEMS View "FACTS" as a Decision Tool

Field View - gvdAll - [Geographic View 1]

Packet Edit View Query Tools Redlines Options Custom Admin Window Help

Info [Icons]

**Fault Cable - Review Loop Trace Detail**

Fail Date	From Device #	To Device #	Wire Description	Operation Voltage	Install Date
2003-10-04	8S7852	8Y48948	2/c 2AL (506)	12.5/7.2 KV	1972-00
2000-11-05	8S7852	8Y48948	2/c 2AL (506)	12.5/7.2 KV	1972-00
2003-01-08	8X48948	8Y48951	2/c 2AL (506)	12.5/7.2 KV	1972-00
2003-08-25	8Y48950	8X48952	2/c 2AL (506)	12.5/7.2 KV	1972-00

Copy OK

X: -30478413 Y: -1063702560 Zoom: 2654



# GEMS View "FACTS" as a Decision Tool

Paste in Excel for Replacement Justification.

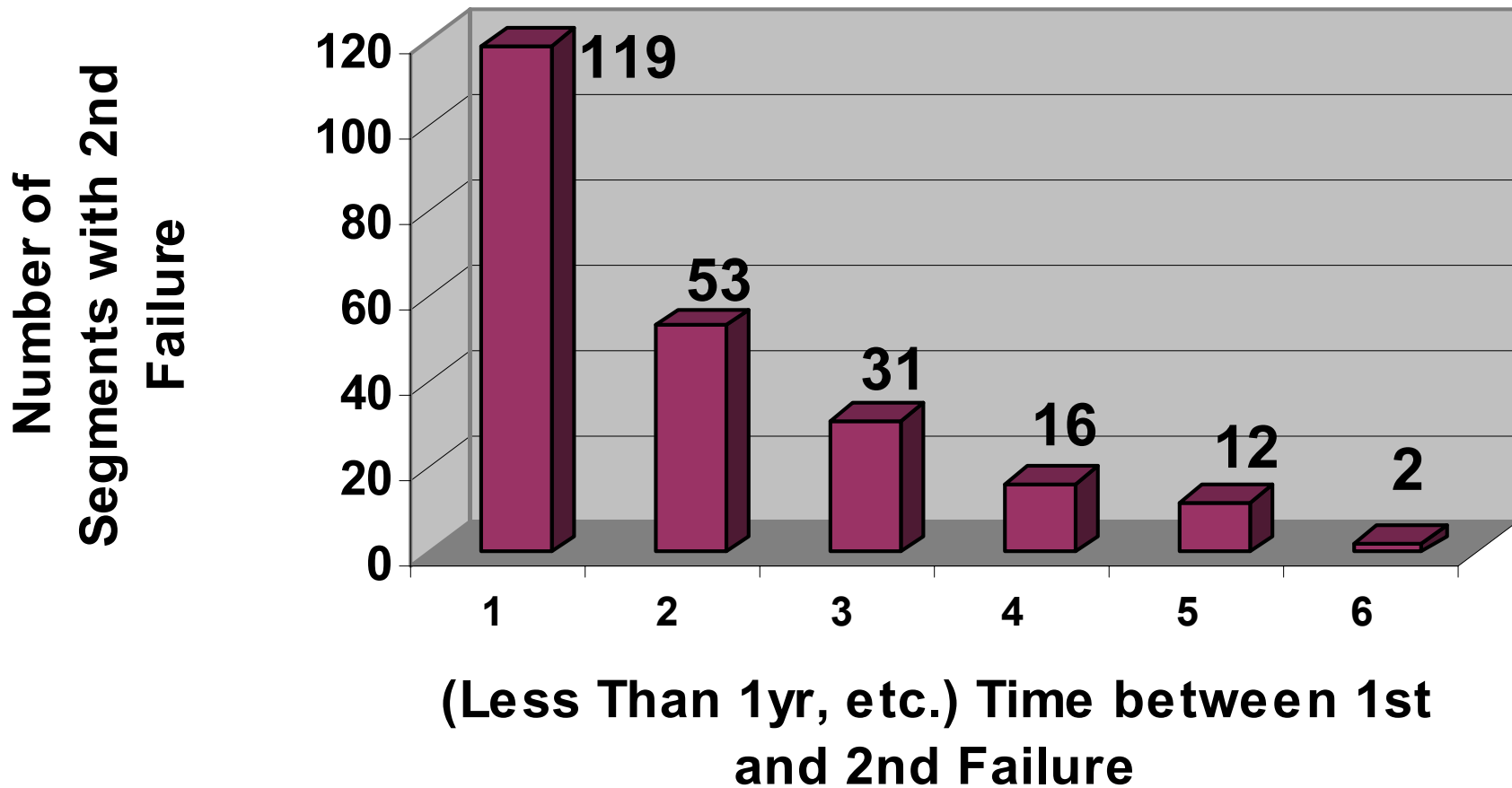
Fail Date	From Device #	To Device #	Wire Description	Operation Voltage	Install Date	Segment Length	Length Rp (feet)	Work Order #
10/04/2003	8S7852	8Y48948	2/c 2AL (506)	12.5/7.2 KV	1972-00	626	1	8215105
11/05/2000	8S7852	8Y48948	2/c 2AL (506)	12.5/7.2 KV	1972-00	626	0	600316231
01/08/2003	8X48948	8Y48951	2/c 2AL (506)	12.5/7.2 KV	1972-00	750	2	8535932
08/25/2003	8Y48950	8X48952	2/c 2AL (506)	12.5/7.2 KV	1972-00	339	1	8214399
09/24/2002	8X48951	8X48950	2/c 2AL (506)	12.5/7.2 KV	1972-00	317	2	8209864
10/17/2001	8X48951	8X48950	2/c 2AL (506)	12.5/7.2 KV	1972-00	317	8	8851623
No Fault	8S7855	8Y48952	2/C 2AL (506)	12.5/7.2 KV	1972-00	1353		

**3 years between 1<sup>st</sup> and 2<sup>nd</sup> failures.**

**<1 year between 1<sup>st</sup> and 2<sup>nd</sup> failures.**

# Additional Results from the Real-time Database "FACTS"

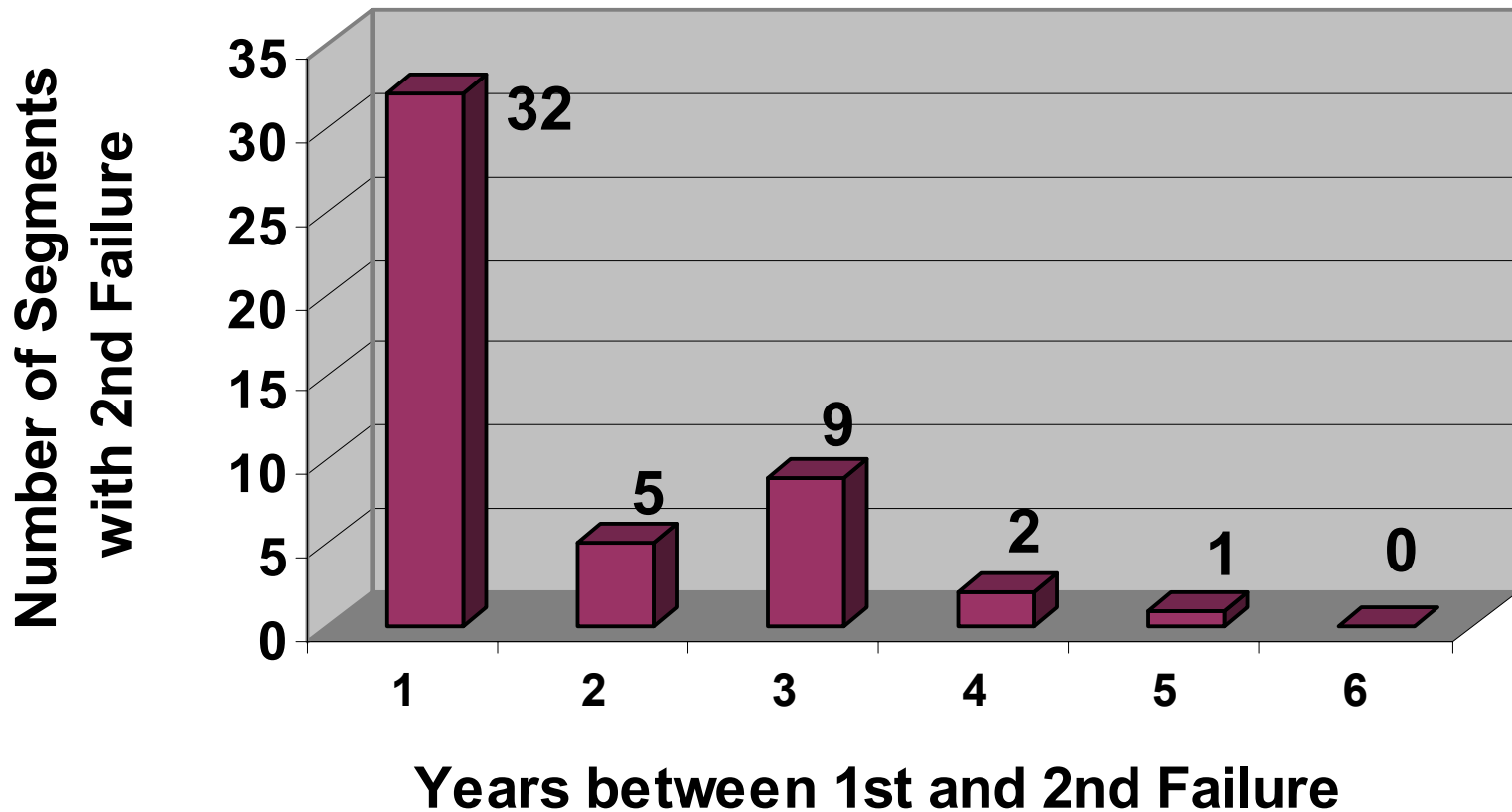
Real-time Database (For 1999 thru 2004) has 1578 Failed 2/C-2AL(Bare Conc.) (1970 to 1984) Cable Segment Records of which 233 had a second Failure.





# Additional Results from the Real-time Database "FACTS"

**Real-time Database (For 1999 thru 2004) has 327 Failed 2/c-0AL Bare Conc. (1970 to 1984) Segment Records of which 49 had a second Failure.**

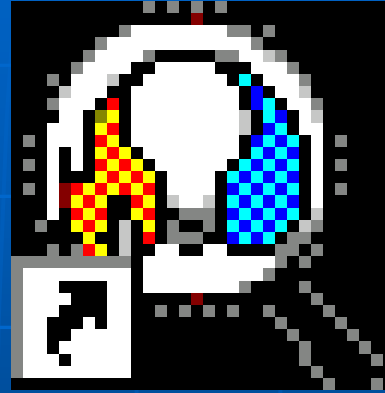


# Conclusions

- Analysis shows:
  - That old cable failure rates are high compared to the national average indicated in 1994.
  - There are a significant number of old cable segments where the 2<sup>nd</sup> failure is more than a year down the road.
  - The 1984 and newer Jacketed primary is performing about 9 times better than the old bare concentric cable.
  - Shows that crews are not replacing cable when criteria is met.
- After bringing this to the attention of Crews and Engineering, they now have accepted and trust the Failed Accessory and Cable Tracking System.
- Capital can be saved with the criteria implemented in 1996 of only replacing those segments that have a 2<sup>nd</sup> failure within 1 year of the 1<sup>st</sup>.
- The Decision Tool implemented in 2000 allows for more aggressive cable replacement through informed decisions. Whether to replace a half-loop or whole loop URD primary.
- Future plan: Investigate alternatives to enhance the criteria for cable replacement to meet performance based rates implemented by state commission.

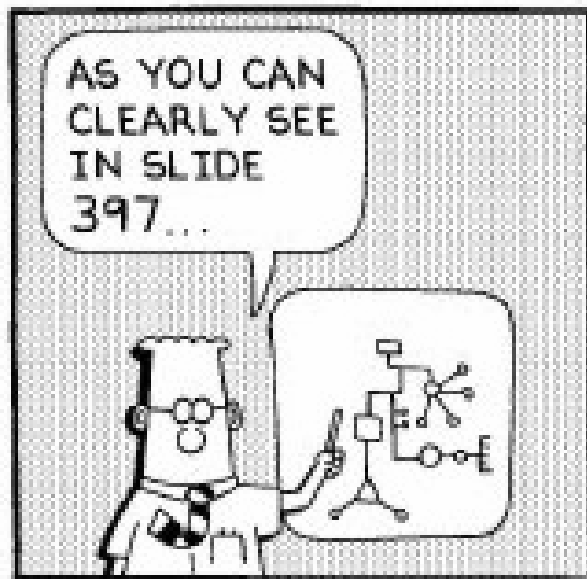
# Using GEMS View

Failures Accessory and Cable Tracking System



GEMS View WAN.Ink

**This was a brief overview to prevent this from happening.**



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