Florida AIHA Fall Conference 2023:

Comparison of STS Methodologies

Jacobs

Who am I?

- 2003 – Graduated with B.S. in Environmental Studies, which didn't cover Industrial Hygiene
- 2008 – Origin story: Iowa Mom & Pop paint manufacturer
- 2011 – IH services, focusing on Workman's Compensation Insurance
- 2016 – Certification
- 2018 – Moved to Florida and focused 100% on IH at KSC on KEMCON/ NEMCON
- 2022 – Switched to KSC's TOSC/ COMET contract focusing on IH for flight hardware manufacturing and processing

Worm?   Meatball?

Image credits: NASA

Disclaimer

- This presentation is for informative purposes and only represents my personal views or opinions. This presentation is not to be interpreted as the views, opinions, and/or requirements of Jacobs Technology or NASA.

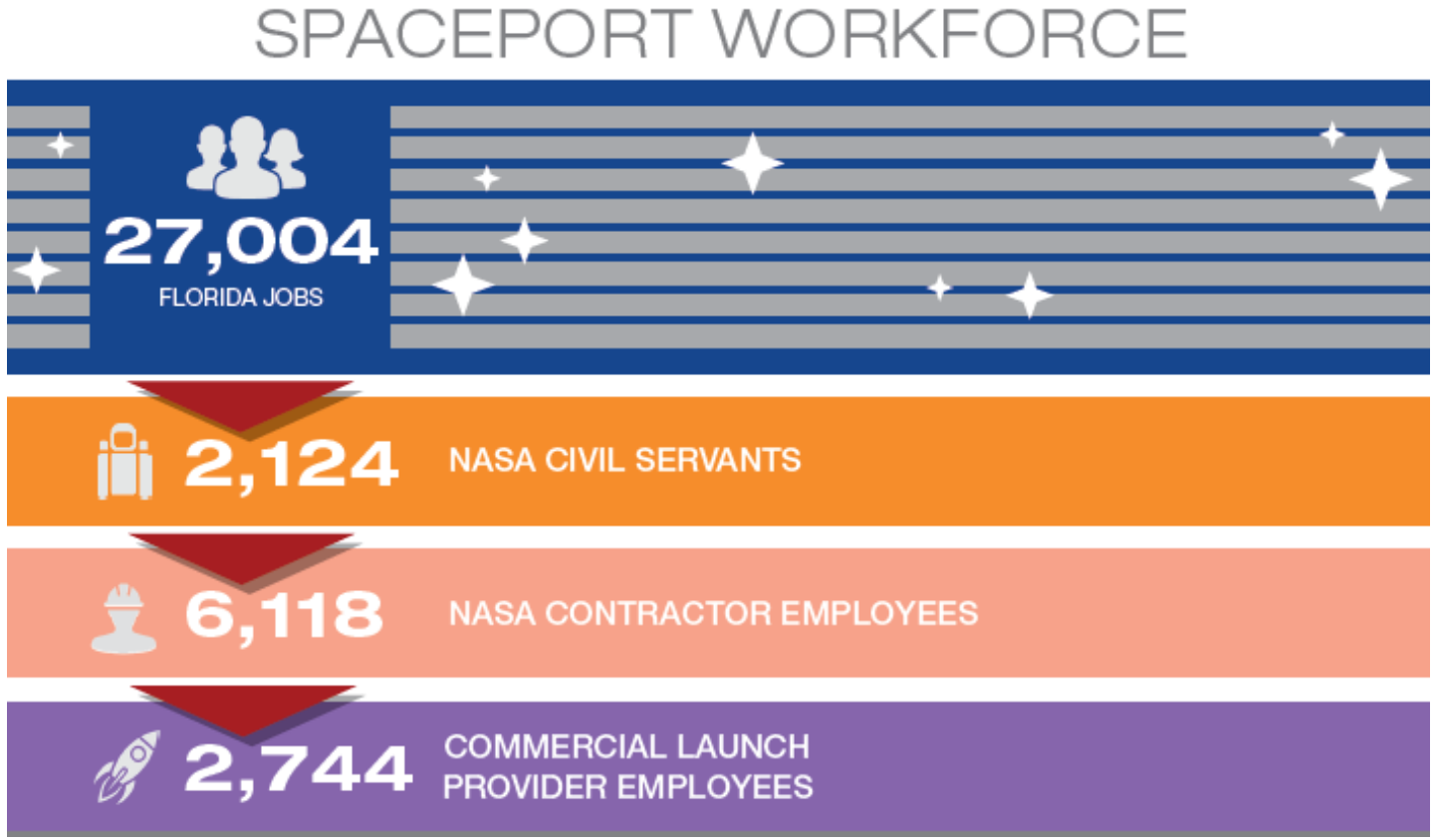
Welcome to NASA…

Agenda

- KSC Workforce population
- Problem Statement
- Hearing Conservation Program refreshers and process summary
- KSC COMET's actions taken
- Alternative STS Methodology
- The numbers
- Final thoughts

Kennedy Space Center- Population

National Aeronautics and Space Administration



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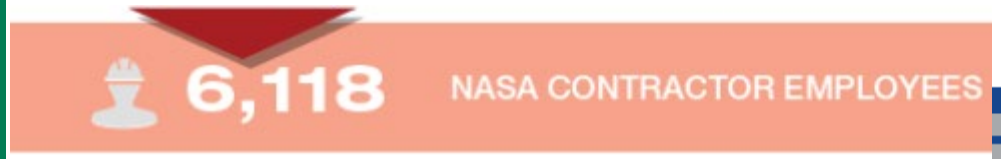
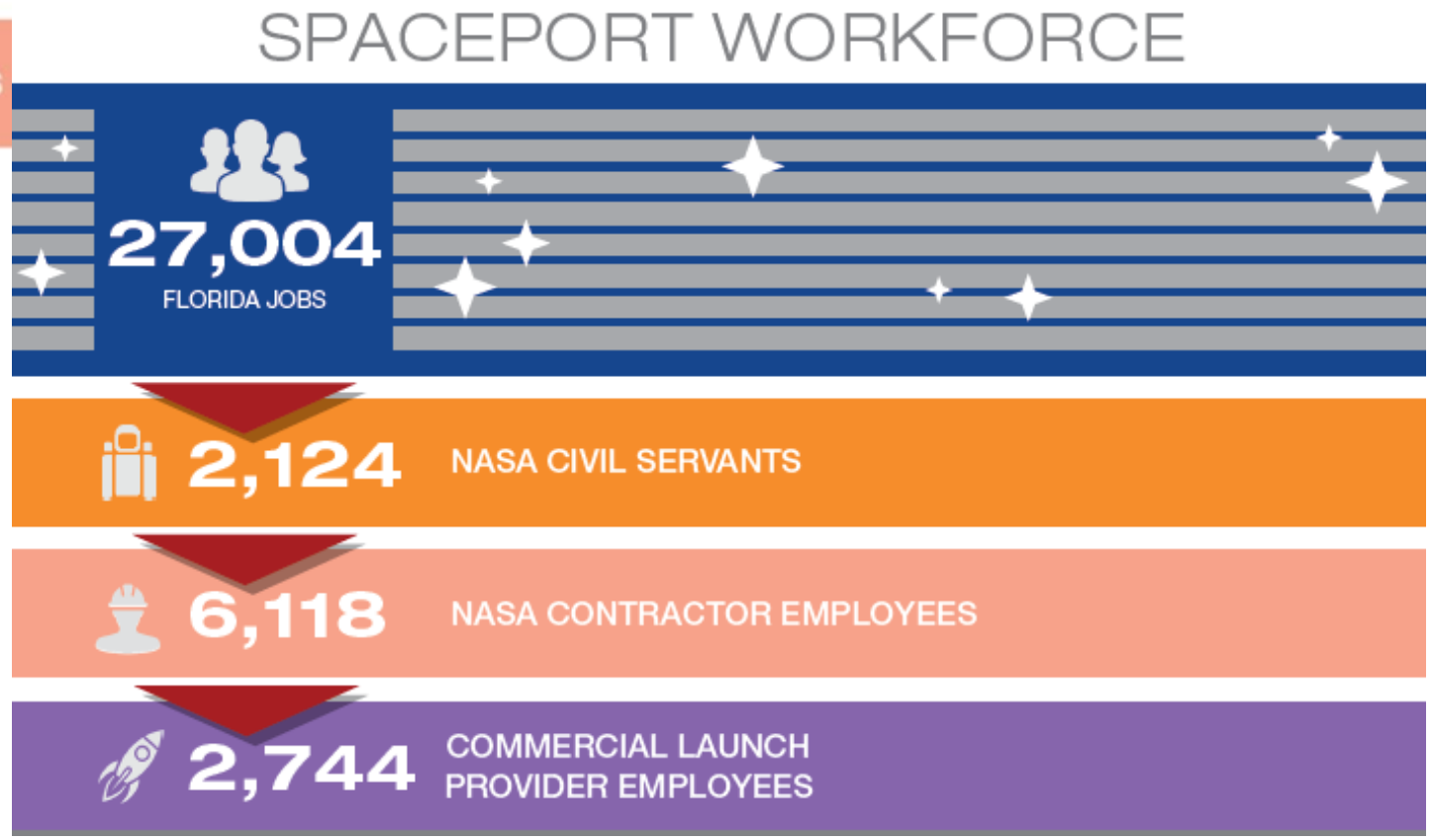
Kennedy Space Center- Population



- This is where I reside on the COMET contract.
- COMET accounts for roughly 1/3 of the Contractor population.
- Our Hearing Conservation Program consists of approx. 450 individuals.



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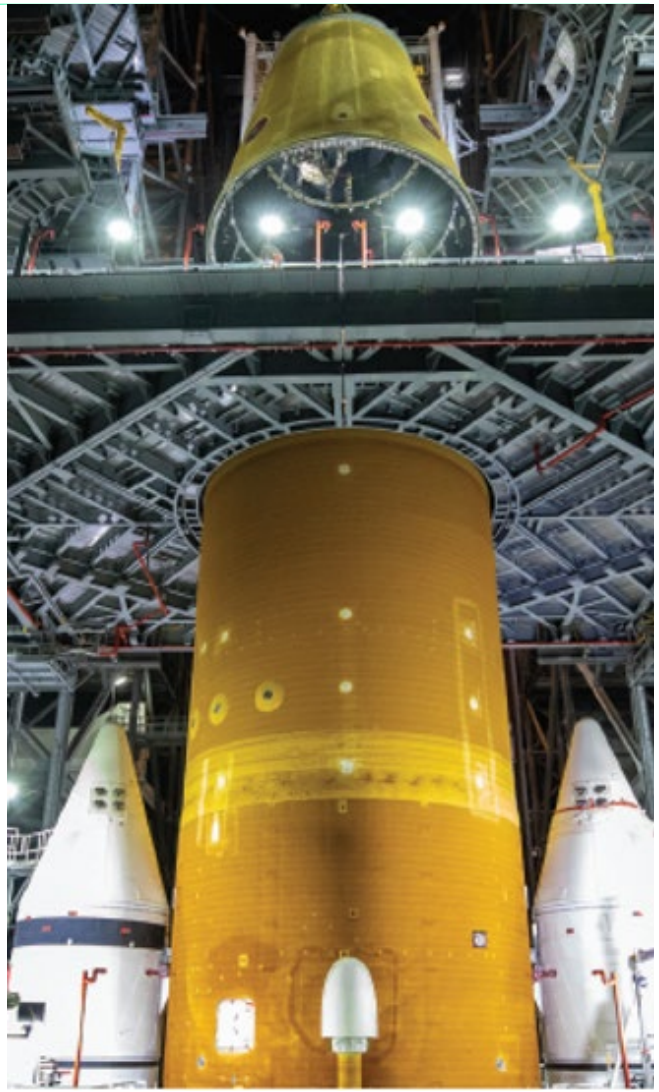
Problem Statement – What can be done to reduce the number of STSs?

- Beginning of TOSC (2013-2015), there were zero OSHA Recordable STSs.
- Near the end of TOSC (2022), we recorded 5 STSs on the OSHA log.



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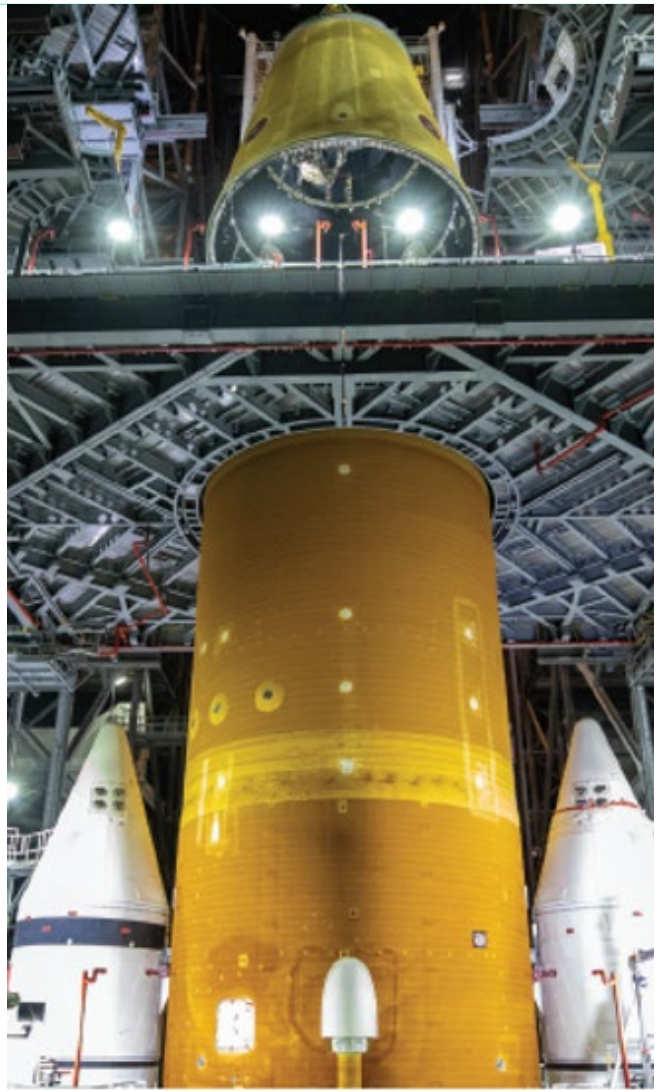
So, what was our plan…?

If you know, you know

Problem Statement – What can be done to reduce the number of STSs?

- One major limitation is the scope of work for TOSC/COMET.



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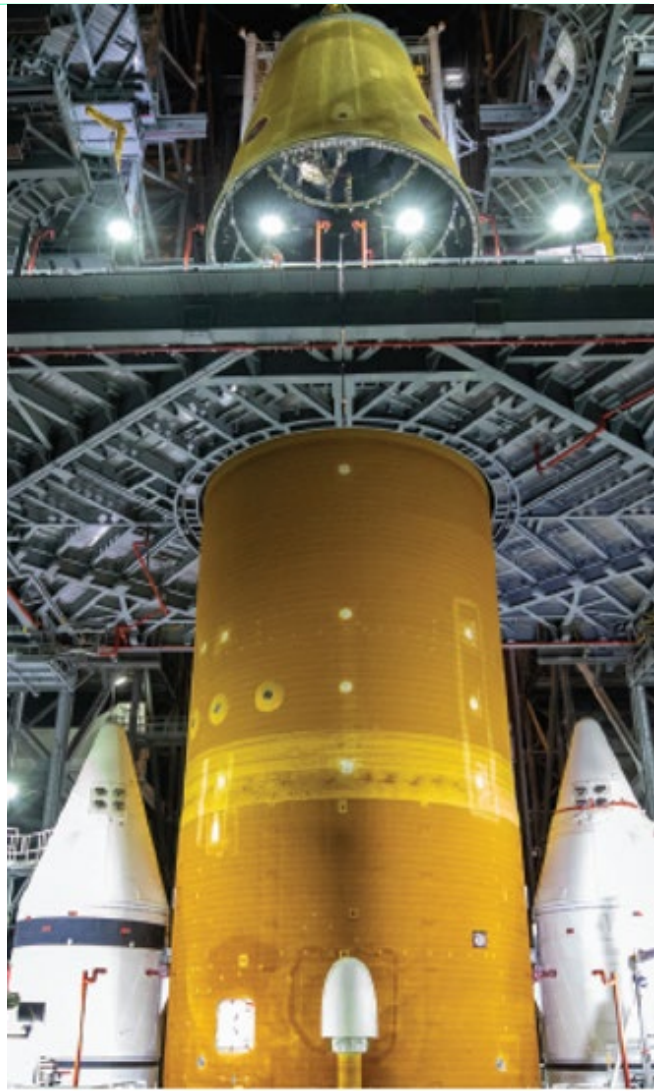
Problem Statement – What can be done to reduce the number of STSs?

- Traditional methods yielded mixed results:
  - Training, available HPDs, annual audiograms
- Needed to think outside the box. [FORESHADOWING]



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Background

- 29 CFR 1910.95 – Occupational Noise Exposure
- Paragraph (c) establishes Hearing Conservation Program criteria:
  - 1910.95(c)(1): *The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (o) of this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale (slow response) or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with appendix A and Table G16a, and without regard to any attenuation provided by the use of personal protective equipment.*

- Other program elements include:
  - Monitoring,
  - Baseline audiogram,
  - Annual audiograms,
  - Evaluation of audiogram,
  - Hearing protectors,
  - Attenuation,
  - Training, and
  - Appendices of 1910.95 which specific methodology

Key Definitions

- Standard Threshold Shift (STS):
  - 1910.95(g)(10)(i): *As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average 10 dB or more at 2000, 3000, and 4000 Hz in either ear.*
- Audiometric Zero:
  - 1904.10(a): *…averaged at 2000, 3000, and 4000 Hz…*
- Hertz (Hz) (for frequencies, not the Tom Brady commercials):
  - Unit of measure for frequencies.
- Frequencies (as related to sound):
  - The number of times per second that sound pressure wave repeats itself.
  - Normal human hearing ranges between 20 Hz and 20,000 Hz.
    - Above 20,000 Hz is considered Ultrasound, think dog whistle.
    - Below 20 Hz is considered Infrasound, think gator vibrating water.

Key Concepts

- STS Recordability:
  - 1904.10(a): *If an employee's hearing test (audiogram) reveals that the employee has experienced a work-related STS in hearing in one or both ears, and the employee's total hearing level is 25 decibels (dB) or more above audiometric zero in the same ear(s) as the STS, you must record the case on the OSHA 300 Log.*
- Work Related:
  - 1904.5 – Determination of work-relatedness
    - Seems like a straightforward topic but is open to interpretation.
- Age Correction:
  - 1910.95, Appendix F – Calculations and Application of Age Corrections to Audiograms
    - OSHA allows you to apply a "correction factor" to audiogram results to account for age.
    - Meant to factor in natural, age-related hearing loss

Summary of KSC's HCP Process

- Upon enrollment, participants receive a baseline audiogram from the on-center Occupational Health Facility (OHF).
  - Note: some baselines in our current HCP date back to early 90's. NASA has a procedural requirement for baselines to be transferred from contract to contract and follow an employee so long as their job duty stays the same.

- An annual audiogram is completed for each year of enrollment.

- Audiograms are reviewed by an OHF physician and determined if the results are an STS.
  - If the audiogram shows an STS, a confirmation audiogram is scheduled with the employee within 30 days.
    - The HCP Manager reaches out to the employee to discuss any concerns they have, review their work area and potential noise sources, and confirms they have appropriate hearing protection. Also, reminds the employee to limit their noise exposure for 18 hours prior to their next audiogram appointment.

- If the confirmation audiogram also shows an STS, the STS is confirmed.
  - The on-center environmental health contract (NEMCON) is notified and starts a Noise Hazard Assessment – STS Evaluation.
  - The HCP Manager receives and reviews the historical audiograms from the OHF.
  - The HCP Manager begins an STS case file, schedules the employee for refresher training on hearing protection, and schedules them for fit checking their hearing protection.

Summary of KSC's HCP Process

- Once the Noise Hazard Assessment is completed, the STS case file is submitted to a 3rd party audiologist (non-KSC) for review and their determination of work relatedness.
  - By contract, the on-center OHF does NOT make work relatedness determinations.

- If the audiologist determines it is NOT work related:
  - Employee still receives refresher training and fit checking of their hearing protection.

- If the audiologist determines it IS work related:
  - Employee receives refresher training and fit checking of their hearing protection.
  - STS is recorded on the OSHA Log.
  - STS is logged into the COMET Incident Reporting Tool (IRT) and uploaded into the NASA Mishap Information System (NMIS).
  - The IRT and NMIS entries are completed and associated corrective actions are tracked.
  - Once all corrective actions are completed, the entries are submitted for closure.

Still with me?

- Let's recap…

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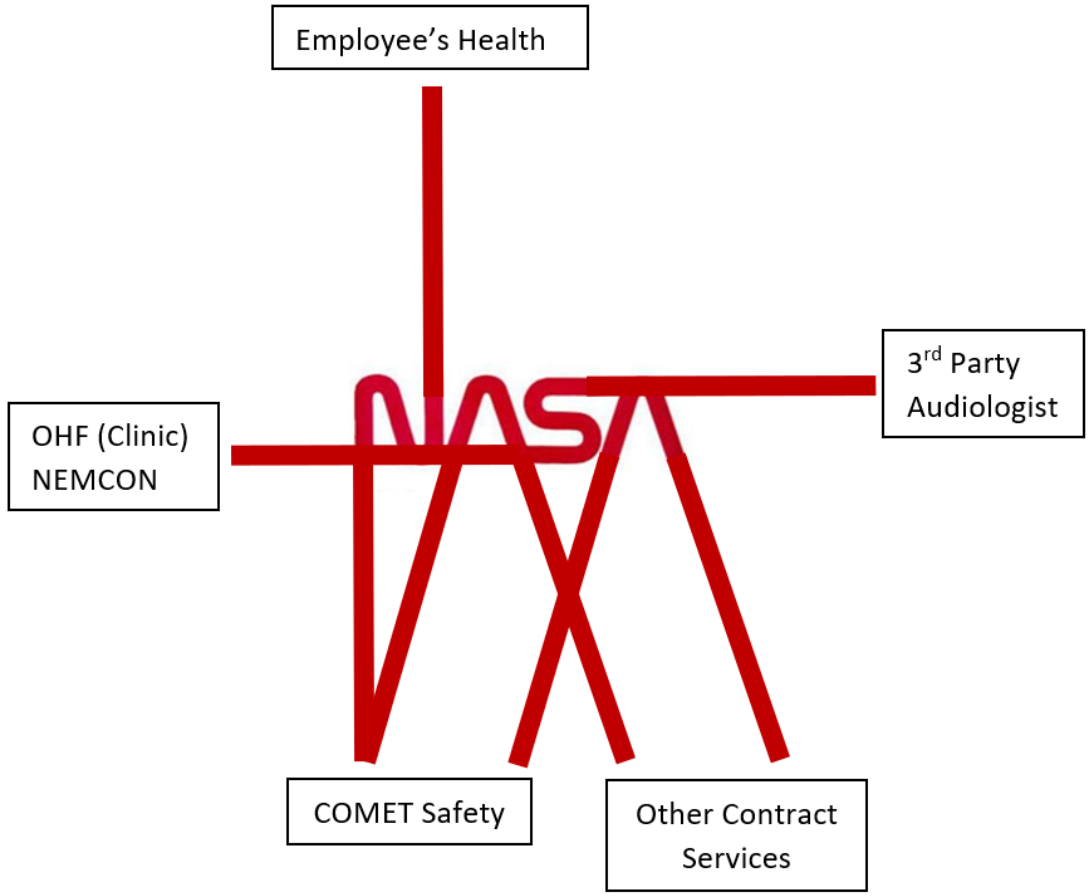

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Actions Taken

Focused on high hazardous noise operations, starting with the Crawler and it's 109 dB engine room.

Actions Taken

A couple of theories emerged regarding HPD use and personnel habits.

- The standard comm system was bulky, heavy, hot, and muffled communication when using dual HPD.

- HPD users were not inserting plugs properly.

Actions Taken

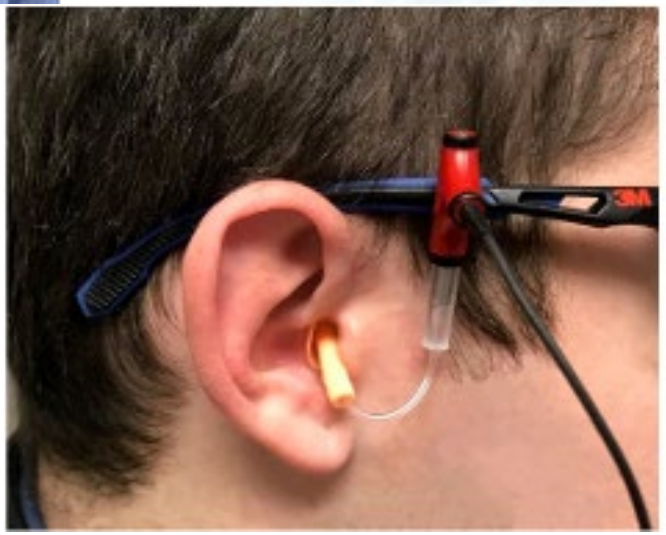
Evaluated the Crawler group's existing hearing protection devices and looked for new, best available technology.

- The 3M LEP-200 has a Noise Reduction Rating (NRR) of up to (tip dependent) 30 dB and provides wireless in-ear communication.
- Uses a noise cancelling technology to reduce background environmental noise.
- The dual function as an earplug and communication device eliminated the need for the traditional comms headset for 80% of the tasks around the Crawler.
- Can also be worn under an earmuff headset if dual protection is required (e.g. Crawler engine room).

Actions Taken

While looking for best available technology, found 3M's EARfit program.

- Uses dual sensor technology to compare ambient environmental noise levels to those in the ear canal behind the hearing protection device.
- The program software creates individual Personal Attenuation Rates (PAR) for the different protection devices that are tested.
- Able to detect subtle differences in the fit of an ear plug that are otherwise invisible to wearer.
- Hearing protection can be customized to each user's potential exposure based on the different PARs at each frequency.

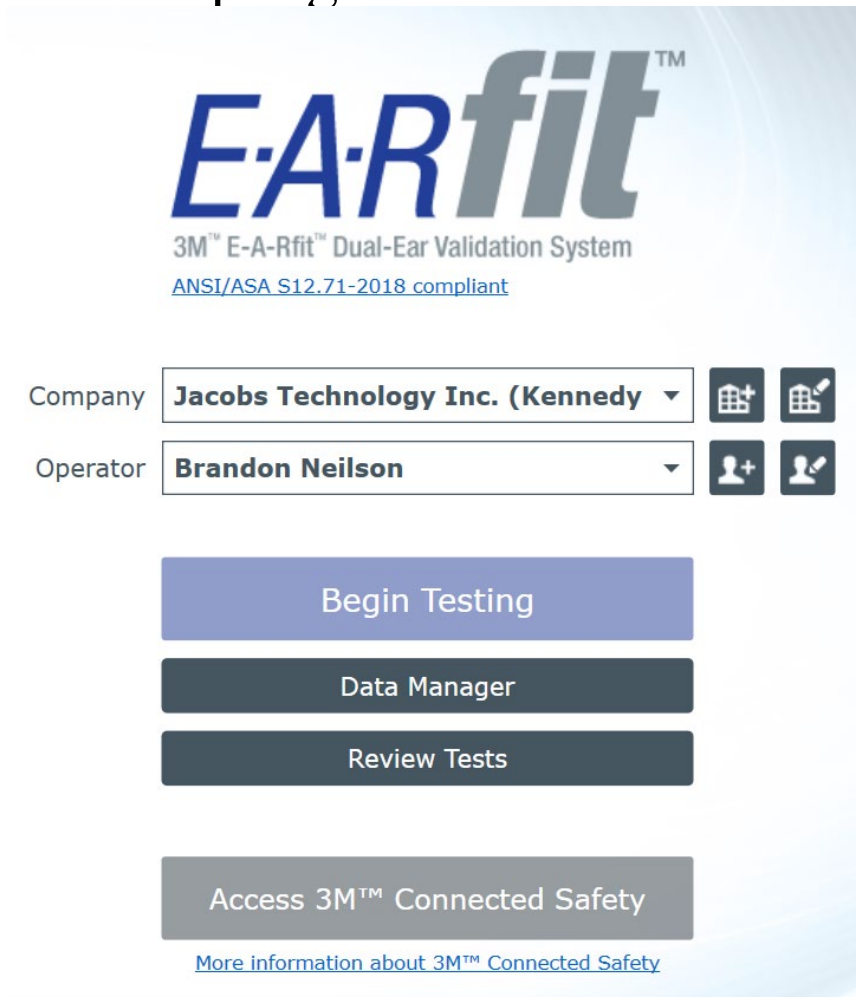


Actions Taken

While looking for best available technology, found 3M's EARfit program.

- There were some challenges:
  - Off center data management software. IT had concerns about having to connect to an off-center, third-party computer system through NASA's firewall.
    - Worked with IT to devise a localized solution with downloadable patches.

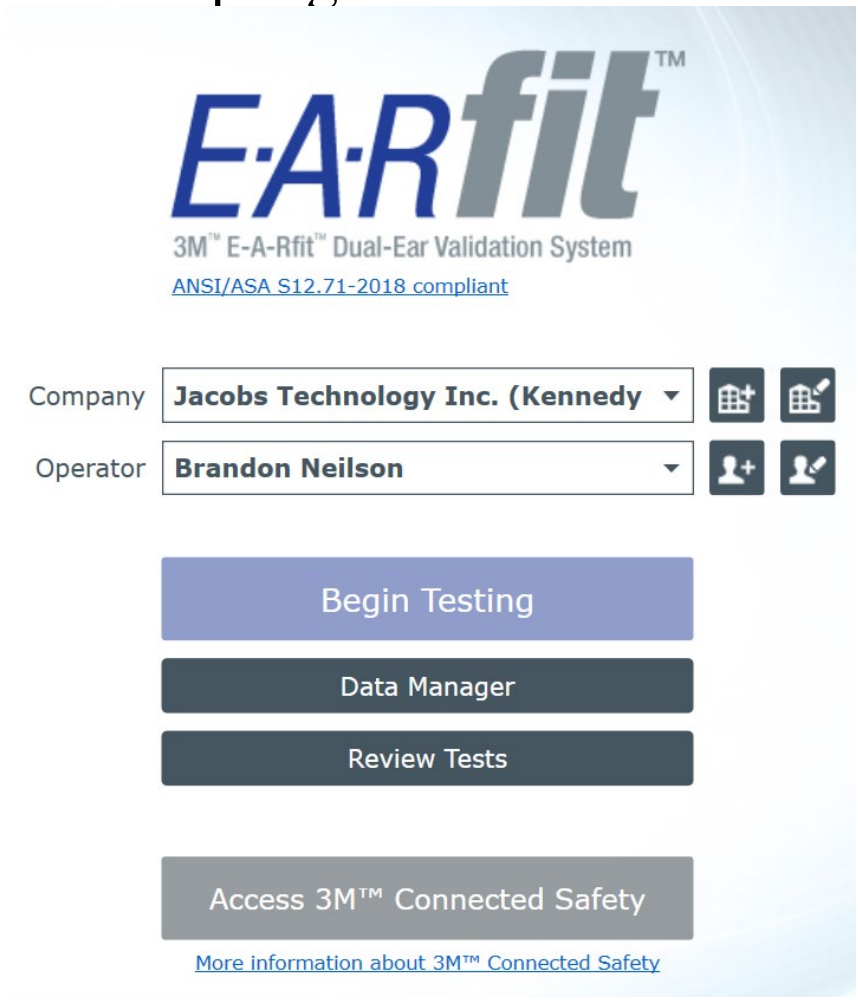
  - The software stores user data. IT had concerns that the data being stored might be a HIPAA violation.
    - Developed a waiver for individuals to review and approve prior to use allowing the software to store their information.
    - Does NOT store any medical data, just how each type of hearing protection fits.



Actions Taken

While looking for best available technology, found 3M's EARfit program.

- Have incorporated fit testing into our HCP with biennial testing of our participants.
  - Training certification requirement



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The actions taken are great…but …that's not why we're here.

Problem Statement – What can be done to reduce the number of STSs?

- Traditional methods yielded mixed results:
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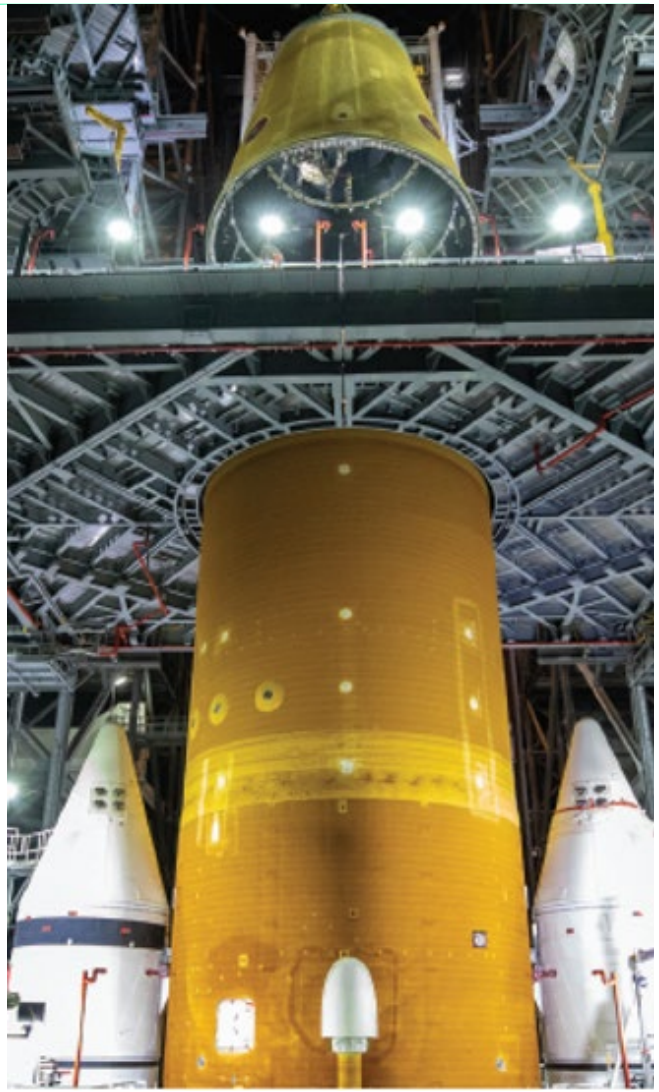
- Needed to think outside the box. [FORESHADOWING]



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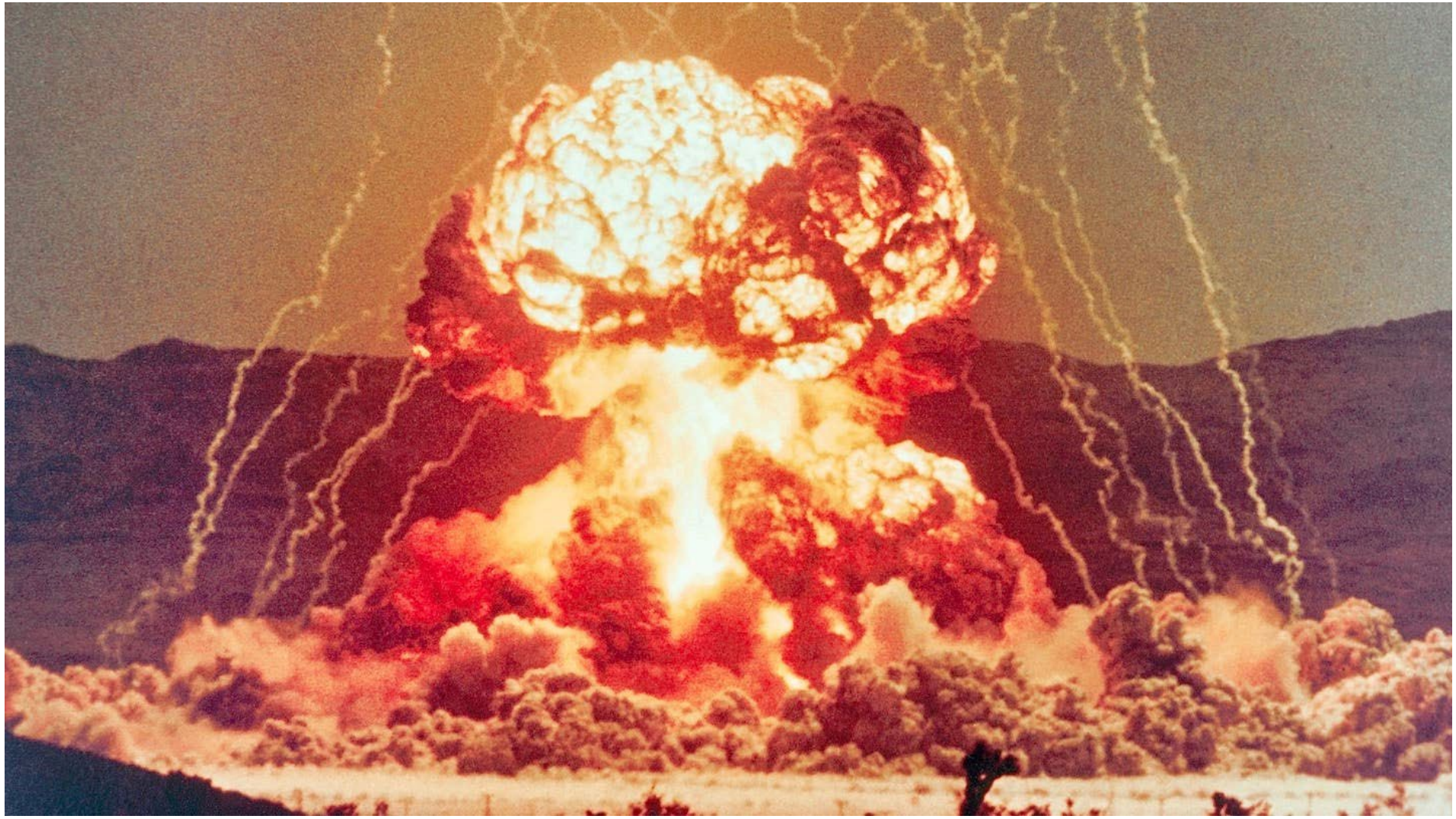
So, let’s change the whole STS methodology.



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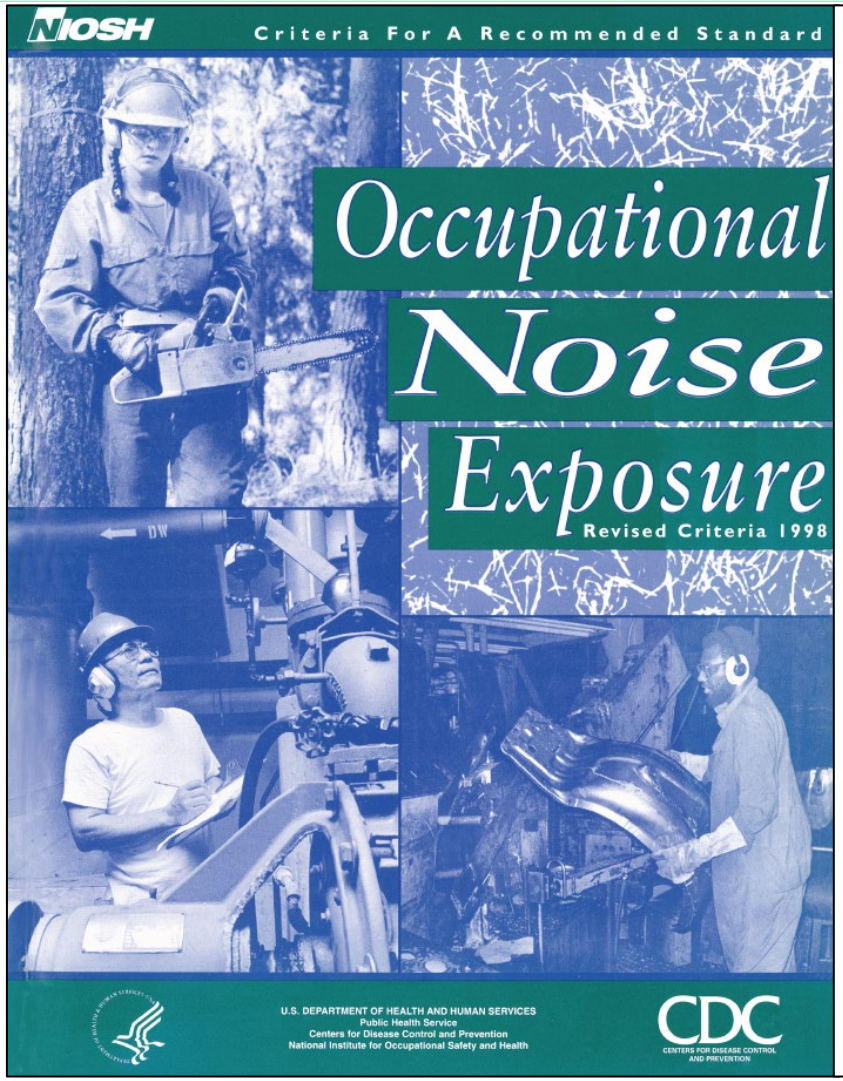
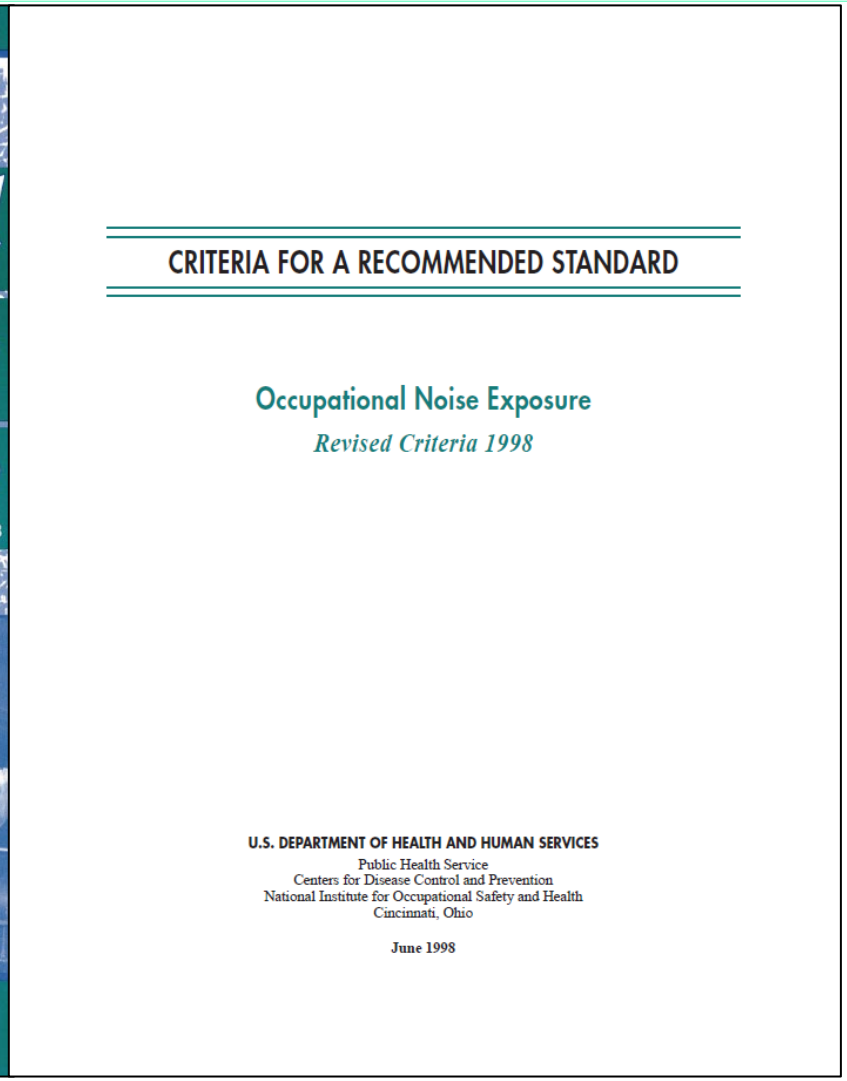
NIOSH– Occupational Noise Exposure (1998)




CRITERIA FOR A RECOMMENDED STANDARD

Occupational Noise Exposure

Revised Criteria 1998

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Cincinnati, Ohio

June 1998

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NIOSH– Occupational Noise Exposure (1998)

Recommends OSHA adopt the following:

- 85 dBA 8-hr TWA
  - 40-year lifetime exposure at 85 dBA lowers the risk of Noise Induced Hearing Loss (NIHL) to 8%.
  - Under OSHA's 90 dBA PEL the risk of NIHL is 25%.
- 3 dB exchange rate
- Improved criterion for identifying STSs to include an increase of 15 dB in the hearing threshold level (HTL) at 500, 1000, 2000, 3000, 4000, or 6000 Hz in either ear. The OSHA criterion (called Standard Threshold Shift) has a relatively low identification rate.
- No longer use age correction on individual audiograms.
- A variable NRR derating scheme by subtracting from the NRR 25% (earmuffs), 50% (formable earplugs), and 70% (all other earplugs).
  - OSHA derates NRR by one-half (50%) for all types of hearing protectors.

Look familiar?

Recommends OSHA adopt the following:

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  - Under OSHA's 90 dBA PEL the risk of NIHL is 25%.
- 3 dB exchange rate ← ACGIH TLV
- Improved criterion for identifying STSs to include an increase of 15 dB in the hearing threshold level (HTL) at 500, 1000, 2000, 3000, 4000, or 6000 Hz in either ear. The OSHA criterion (called Standard Threshold Shift) has a relatively low identification rate.
- No longer use age correction on individual audiograms.
  - Per OSHA, age correction is optional.
- A variable NRR derating scheme by subtracting from the NRR 25% (earmuffs), 50% (formable earplugs), and 70% (all other earplugs). ← Used at KSC and periodically in industry
  - OSHA derates NRR by one-half (50%) for all types of hearing protectors.

Closer look at the hearing shift recommendations:

Recommends OSHA adopt the following:

- Improved criterion for identifying STSs to include an increase of 15 dB in the hearing threshold level (HTL) at 500, 1000, 2000, 3000, 4000, or 6000 Hz in either ear. The OSHA criterion (called Standard Threshold Shift) has a relatively low identification rate.
  - OSHA uses the HTL of 10 dB of the Audiometric Zero, an average of 2000, 3000, and 4000 Hz.

- No longer use age correction on individual audiograms.
  - OSHA uses age correction per 1910.95 Appendix F – Calculations and Application of Age Corrections to Audiograms.
  - Intended to account for age related hearing loss.

A deep dive into the numbers

Based on the current HCP process, I only had access to a handful of STS case files. But some of those cases had audiogram histories dating back to the 1990's.

So, I started plugging numbers into Excel.

A deep dive into the numbers

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1																
2			Left Freq (Hz)							Right Freq (Hz)						
3	Age	Year	500	1000	2000	3000	4000	6000	8000	500	1000	2000	3000	4000	6000	8000
4	36	2001 (B)	0	5	0	30	15	20	0	0	0	0	15	10	10	35
5	37	2002	5	5	0	30	20	25	20	0	0	0	20	10	15	40
6	38	2003	0	5	0	30	10	20	15	0	0	0	20	20	10	40
7	39	2004	5	10	0	30	20	25	25	0	0	0	15	5	25	55
8	40	2005	5	5	0	30	25	40	30	0	0	0	15	15	15	50
9	41	2006	5	5	5	20	20	15	40	0	5	0	20	15	20	45
10	42	2007	5	10	0	35	30	25	50	0	0	-5	15	15	10	45
11	43	2008	5	10	0	35	35	20	35	5	5	0	15	15	10	55
12	44	2009	5	5	0	35	35	30	50	0	0	0	20	15	10	50
13	45	2010	5	10	5	35	30	35	60	5	0	0	15	15	10	60
14	46	2011	5	5	0	40	35	30	50	5	5	0	20	10	15	70
15	47	2012	5	5	0	35	40	25	50	5	10	0	20	10	15	60
16	48	2013	5	10	0	35	30	30	60	0	0	0	15	15	15	55
17	49	2014	5	10	5	40	40	30	60	5	0	0	25	20	10	60
18	50	2015	5	10	0	40	40	30	60	0	0	0	20	15	10	60

A deep dive into the numbers

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1																				
2			Left Freq (Hz)							Right Freq (Hz)							OSHA Shift			
3	Age	Year	500	1000	2000	3000	4000	6000	8000	500	1000	2000	3000	4000	6000	8000	L	AC L	R	AC R
4	36	2001 (B)	0	5	0	30	15	20	0	0	0	0	15	10	10	35	0	0	0	0
5	37	2002	5	5	0	30	20	25	20	0	0	0	20	10	15	40	1.66667	1.33333	1.66667	1.33333
6	38	2003	0	5	0	30	10	20	15	0	0	0	20	20	10	40	-1.6667	-2.3333	5	4.33333
7	39	2004	5	10	0	30	20	25	25	0	0	0	15	5	25	55	1.66667	0.33333	-1.6667	-3
8	40	2005	5	5	0	30	25	40	30	0	0	0	15	15	15	50	3.33333	2	1.66667	0.33333
9	41	2006	5	5	5	20	20	15	40	0	5	0	20	15	20	45	0	-1.3333	3.33333	2
10	42	2007	5	10	0	35	30	25	50	0	0	-5	15	15	10	45	6.66667	4	0	-2.6667
11	43	2008	5	10	0	35	35	20	35	5	5	0	15	15	10	55	8.33333	5.33333	1.66667	-1.3333
12	44	2009	5	5	0	35	35	30	50	0	0	0	20	15	10	50	8.33333	5	3.33333	0
13	45	2010	5	10	5	35	30	35	60	5	0	0	15	15	10	60	8.33333	4.33333	1.66667	-2.3333
14	46	2011	5	5	0	40	35	30	50	5	5	0	20	10	15	70	10	5.33333	1.66667	-3
15	47	2012	5	5	0	35	40	25	50	5	10	0	20	10	15	60	10	5	1.66667	-3.3333
16	48	2013	5	10	0	35	30	30	60	0	0	0	15	15	15	55	6.66667	1.33333	1.66667	-3.6667
17	49	2014	5	10	5	40	40	30	60	5	0	0	25	20	10	60	13.3333	7	6.66667	0.33333
18	50	2015	5	10	0	40	40	30	60	0	0	0	20	15	10	60	11.6667	4.66667	3.33333	-3.6667

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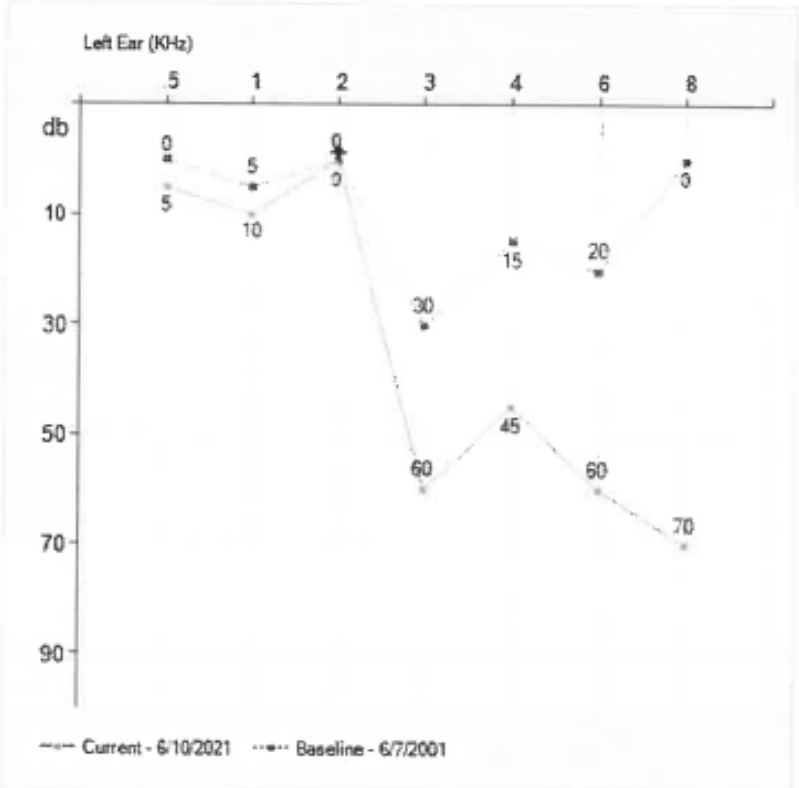
A deep dive into the numbers

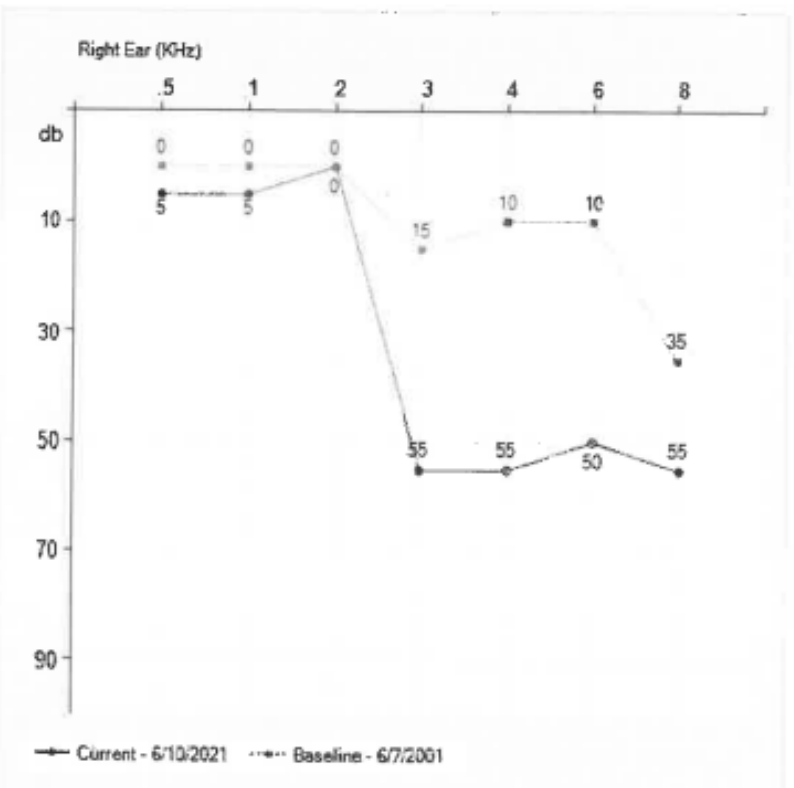
Left Ear Baseline: 6/7/2001
Left Ear STS: 9

Left Ear	.5K	1K	2K	3K	4K	6K	8K	Avg 2,3,4K
Baseline - Age 36	0	5	0	30	15	20	0	15
Age Factor	0	7	5	9	12	16	-	8.67
Current Year - Age 56	5	10	0	60	45	60	70	35
Age Factor	0	10	11	20	28	34	-	19.67
Uncorrected Shift	5	5	0	30	30	40	70	20.00
Age Corrected Shift	5	2	-6	19	14	22	-	9.00

Right Ear Baseline: 6/7/2001
Right Ear STS: **17.33**

Right Ear	.5K	1K	2K	3K	4K	6K	8K	Avg 2,3,4K
Baseline - Age 36	0	0	0	15	10	10	35	8
Age Factor	0	7	5	9	12	16	-	8.67
Current Year - Age 56	5	5	0	55	55	50	55	37
Age Factor	0	10	11	20	28	34	-	19.67
Uncorrected Shift	5	5	0	40	45	40	20	28.33
Age Corrected Shift	5	2	-6	29	29	22	-	**17.33**





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A deep dive into the numbers

		Left Freq (Hz)							Right Freq (Hz)							OSHA Shift					NIOSH Shift
Age	Year	500	1000	2000	3000	4000	6000	8000	500	1000	2000	3000	4000	6000	8000	L	AC L	R	AC R	OSHA STS	NIOSH L & R
36	**2001 (B)**	0	5	0	30	15	20	0	0	0	0	15	10	10	35	0	0	0	0	10	0
37	**2002**	5	5	0	30	20	25	20	0	0	0	20	10	15	40	1.66667	1.33333	1.66667	1.33333	10	20
38	**2003**	0	5	0	30	10	20	15	0	0	0	20	20	10	40	-1.6667	-2.3333	5	4.33333	10	15
39	**2004**	5	10	0	30	20	25	25	0	0	0	15	5	25	55	1.66667	0.33333	-1.6667	-3	10	25
40	**2005**	5	5	0	30	25	40	30	0	0	0	15	15	15	50	3.33333	2	1.66667	0.33333	10	30
41	**2006**	5	5	5	20	20	15	40	0	5	0	20	15	20	45	0	-1.3333	3.33333	2	10	40
42	**2007**	5	10	0	35	30	25	50	0	0	-5	15	15	10	45	6.66667	4	0	-2.6667	10	50
43	**2008**	5	10	0	35	35	20	35	5	5	0	15	15	10	55	8.33333	5.33333	1.66667	-1.3333	10	35
44	**2009**	5	5	0	35	35	30	50	0	0	0	20	15	10	50	8.33333	5	3.33333	0	10	50
45	**2010**	5	10	5	35	30	35	60	5	0	0	15	15	10	60	8.33333	4.33333	1.66667	-2.3333	10	60
46	**2011**	5	5	0	40	35	30	50	5	5	0	20	10	15	70	10	5.33333	1.66667	-3	10	50
47	**2012**	5	5	0	35	40	25	50	5	10	0	20	10	15	60	10	5	1.66667	-3.3333	10	50
48	**2013**	5	10	0	35	30	30	60	0	0	0	15	15	15	55	6.66667	1.33333	1.66667	-3.6667	10	60
49	**2014**	5	10	5	40	40	30	60	5	0	0	25	20	10	60	13.3333	7	6.66667	0.33333	10	60
50	**2015**	5	10	0	40	40	30	60	0	0	0	20	15	10	60	11.6667	4.66667	3.33333	-3.6667	10	60

Any immediate observations at this point?

		Left Freq (Hz)							Right Freq (Hz)							OSHA Shift					NIOSH Shift
Age	Year	500	1000	2000	3000	4000	6000	8000	500	1000	2000	3000	4000	6000	8000	L	AC L	R	AC R	OSHA STS	NIOSH L & R
36	**2001 (B)**	0	5	0	30	15	20	0	0	0	0	15	10	10	35	0	0	0	0	10	0
37	**2002**	5	5	0	30	20	25	20	0	0	0	20	10	15	40	1.66667	1.33333	1.66667	1.33333	10	20
38	**2003**	0	5	0	30	10	20	15	0	0	0	20	20	10	40	-1.6667	-2.3333	5	4.33333	10	15
39	**2004**	5	10	0	30	20	25	25	0	0	0	15	5	25	55	1.66667	0.33333	-1.6667	-3	10	25
40	**2005**	5	5	0	30	25	40	30	0	0	0	15	15	15	50	3.33333	2	1.66667	0.33333	10	30
41	**2006**	5	5	5	20	20	15	40	0	5	0	20	15	20	45	0	-1.3333	3.33333	2	10	40
42	**2007**	5	10	0	35	30	25	50	0	0	-5	15	15	10	45	6.66667	4	0	-2.6667	10	50
43	**2008**	5	10	0	35	35	20	35	5	5	0	15	15	10	55	8.33333	5.33333	1.66667	-1.3333	10	35
44	**2009**	5	5	0	35	35	30	50	0	0	0	20	15	10	50	8.33333	5	3.33333	0	10	50
45	**2010**	5	10	5	35	30	35	60	5	0	0	15	15	10	60	8.33333	4.33333	1.66667	-2.3333	10	60
46	**2011**	5	5	0	40	35	30	50	5	5	0	20	10	15	70	10	5.33333	1.66667	-3	10	50
47	**2012**	5	5	0	35	40	25	50	5	10	0	20	10	15	60	10	5	1.66667	-3.3333	10	50
48	**2013**	5	10	0	35	30	30	60	0	0	0	15	15	15	55	6.66667	1.33333	1.66667	-3.6667	10	60
49	**2014**	5	10	5	40	40	30	60	5	0	0	25	20	10	60	13.3333	7	6.66667	0.33333	10	60
50	**2015**	5	10	0	40	40	30	60	0	0	0	20	15	10	60	11.6667	4.66667	3.33333	-3.6667	10	60

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Any immediate observations at this point?

		Left Freq (Hz)							Right Freq (Hz)							OSHA Shift					NIOSH Shift
Age	Year	500	1000	2000	3000	4000	6000	8000	500	1000	2000	3000	4000	6000	8000	L	AC L	R	AC R	OSHA STS	NIOSH L & R
36	**2001 (B)**	0	5	0	30	15	20	0	0	0	0	15	10	10	35	0	0	0	0	10	0
37	**2002**	5	5	0	30	20	25	20	0	0	0	20	10	15	40	1.66667	1.33333	1.66667	1.33333		20
38	**2003**	0	5	0	30	10	20	15	0	0	0	20	20	10	40	-1.6667	-2.3333	5	4.33333	10	15
39	**2004**	5	10	0	30	20	25	25	0	0	0	15	5	25	55	1.66667	0.33333	-1.6667	-3	10	25
40	**2005**	5	5	0	30	25	40	30	0	0	0	15	15	15	50	3.33333	2	1.66667	0.33333	10	30
41	**2006**	5	5	5	20	20	15	40	0	5	0	20	15	20	45	0	-1.3333	3.33333	2	10	40
42	**2007**	5	10	0	35	30	25	50	0	0	-5	15	15	10	45	6.66667	4	0	-2.6667	10	50
43	**2008**	5	10	0	35	35	20	35	5	5	0	15	15	10	55	8.33333	5.33333	1.66667	-1.3333	10	35
44	**2009**	5	5	0	35	35	30	50	0	0	0	20	15	10	50	8.33333	5	3.33333	0	10	50
45	**2010**	5	10	5	35	30	35	60	5	0	0	15	15	10	60	8.33333	4.33333	1.66667	-2.3333	10	60
46	**2011**	5	5	0	40	35	30	50	5	5	0	20	10	15	70	10	5.33333	1.66667	-3	10	50
47	**2012**	5	5	0	35	40	25	50	5	10	0	20	10	15	60	10	5	1.66667	-3.3333	10	50
48	**2013**	5	10	0	35	30	30	60	0	0	0	15	15	15	55	6.66667	1.33333	1.66667	-3.6667	10	60
49	**2014**	5	10	5	40	40	30	60	5	0	0	25	20	10	60	13.3333	7	6.66667	0.33333	10	60
50	**2015**	5	10	0	40	40	30	60	0	0	0	20	15	10	60	11.6667	4.66667	3.33333	-3.6667	10	60

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A deep dive into the numbers

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1				DOB	4/10/1956																	
2			Left Freq (Hz)							Right Freq (Hz)							OSHA Shift					NIOSH Shift
3	Age	Date	500	1000	2000	3000	4000	6000	8000	500	1000	2000	3000	4000	6000	8000	L	OSHA AC L	R	OSHA AC R	OSHA STS	NIOSH L & R
4	41	3/5/1998	5	5	15	30	20	20	15	5	5	0	15	15	15	10	0	0	0	0	10	0
5	42	3/26/1999	5	5	15	30	25	20	20	5	5	5	15	20	10	15	1.66667	0.33333	3.33333	2	10	5
6	43	2/8/2000	5	10	20	30	30	20	20	0	0	0	15	20	15	20	5	3.33333	1.66667	0	10	10
7	45	4/24/2001	5	10	15	35	25	35	25	5	5	10	20	25	20	20	3.33333	0.66667	8.33333	5.66667	10	15
8	45	1/25/2002	5	5	20	35	35	30	20	0	0	5	15	25	20	20	8.33333	5.66667	5	2.33333	10	15
9	46	4/2/2003	0	5	20	40	35	30	35	0	0	5	20	20	25	20	10	6.66667	5	1.66667	10	20
10	47	2/3/2004	10	5	20	35	35	45	40	10	0	10	25	30	35	65	8.33333	4.66667	11.6667	8	10	55
11	48	2/24/2005	20	10	20	40	35	45	40	10	5	5	25	25	55	60	10	6	8.33333	4.33333	10	50
12	49	3/6/2006	10	5	20	40	35	55	45	5	5	10	25	25	50	65	10	5	10	5	10	55
13	50	2/21/2007	5	10	20	40	40	60	40	5	5	5	25	35	55	60	11.6667	6	11.6667	6	10	50
14	51	2/1/2008	10	5	30	40	45	45	55	5	0	10	25	35	50	65	16.6667	10.6667	13.3333	7.33333	10	55
15	52	5/5/2008	10	10	25	45	50	45	55	10	10	15	25	35	50	55	18.3333	11.3333	15	8	10	45
16	52	3/3/2009	5	5	30	45	50	55	50	5	10	15	30	30	65	60	20	-3.6667	15	8	10	50
17	53	3/8/2010	10	5	35	40	50	50	50	10	5	15	30	40	55	65	20	-4.3333	18.3333	10.6667	10	55
18	54	2/11/2011	15	10	30	45	50	50	45	15	5	15	35	40	70	70	20	-4.6667	20	12	10	60

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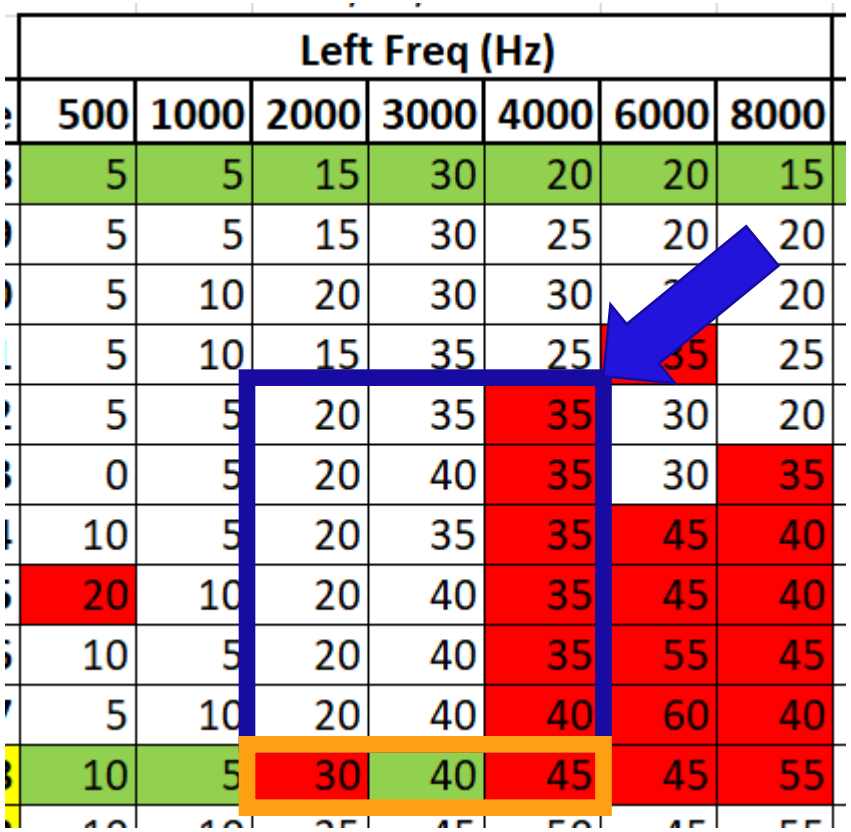
Knowledge Check:

	Left Freq (Hz)						
	500	1000	2000	3000	4000	6000	8000
	5	5	15	30	0	20	15
	5	5	15	30	5	20	20
	5	10	20	30	0	20	20
	5	10	15	35	5	35	25
	5	5	20	35	35	30	20
	0	5	20	40	35	30	35
	10	5	20	35	35	45	40
	20	10	20	40	35	45	40
	10	5	20	40	35	55	45
	5	10	20	40	40	60	40
	10	5	30	40	45	45	55

1. Why didn't these "hearing shifts" trigger an OSHA STS?

Knowledge Check:



Left Freq (Hz)						
500	1000	2000	3000	4000	6000	8000
5	5	15	30	20	20	15
5	5	15	30	25	20	20
5	10	20	30	30		20
5	10	15	35	25	35	25
5	5	20	35	35	30	20
0	5	20	40	35	30	35
10	5	20	35	35	45	40
20	10	20	40	35	45	40
10	5	20	40	35	55	45
5	10	20	40	40	60	40
10	5	30	40	45	45	55

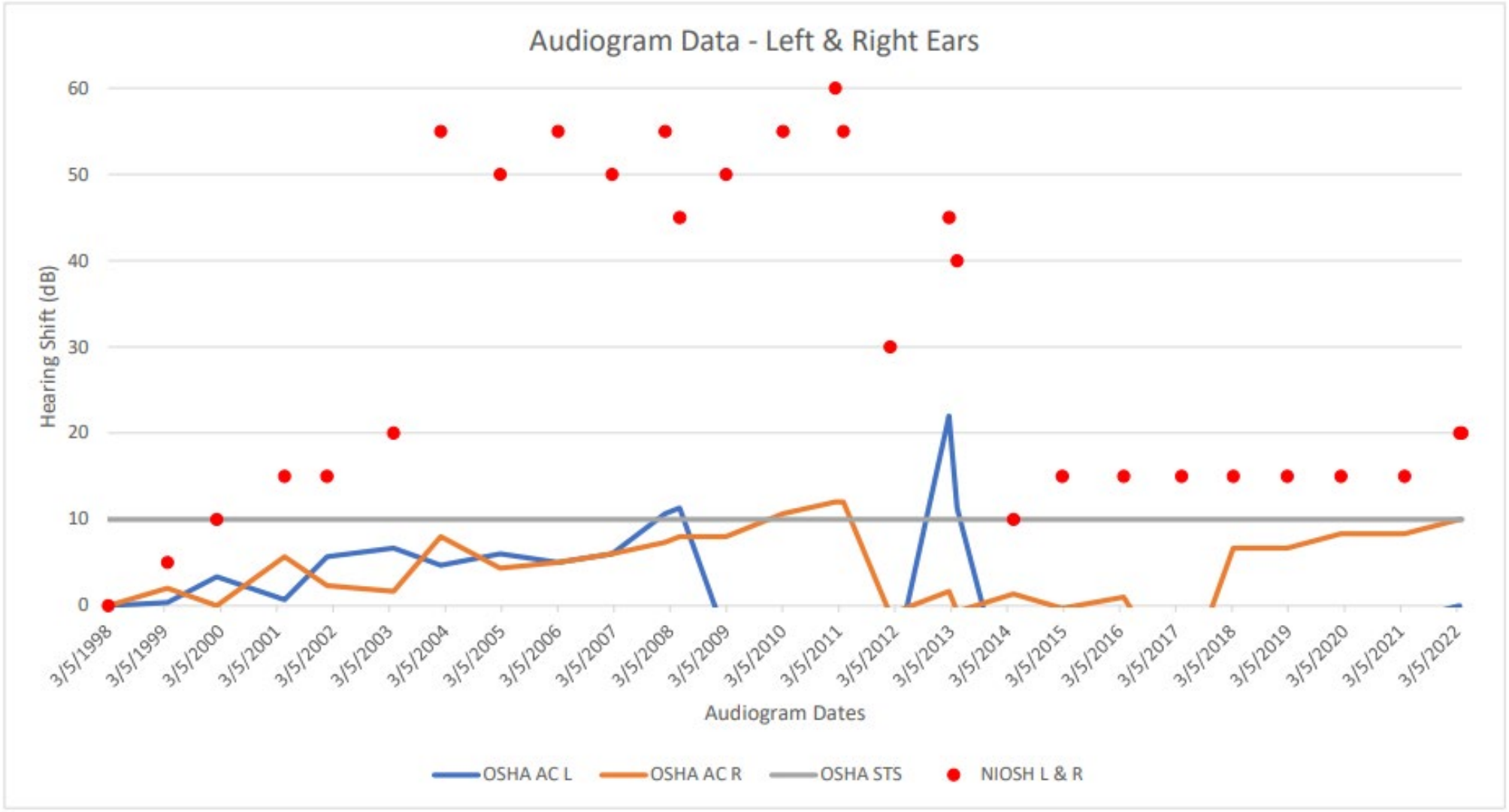
1. Why didn't these "hearing shifts" trigger an OSHA STS?
   - Audiometric Zero: OSHA uses the average of 2000, 3000, and 4000 Hz to identify hearing shifts of 10 dB or more.
   - After 6 years of loss at 4000 Hz, it took another "shift" at 2000 Hz to trigger an OSHA age-corrected STS.

Knowledge Check:

Left Freq (Hz)					OSHA	
2000	3000	4000	6000	8000	L	OSHA AC L
15	30	20	20	15	0	0
15	30	25	20	20	1.66667	0.33333
20	30	30	20	20	5	3.33333
15	35	25	35	25	3.33333	0.66667
20	35	35	[redacted]		8.33333	5.66667
20	40	35			10	6.66667
20	35	35			8.33333	4.66667
20	40	35			10	6
20	40	35			10	5
20	40	40			11.6667	6
30	40	45			16.6667	10.6667

1. Why didn't these "hearing shifts" trigger an OSHA STS?
   - It's also a trick question, based on whether or not you are using the allowed Age Correction.
   - 1910.95 Appendix F – Age Correction Calculations
   - 1904.10 – Recording Criteria for Cases Involving Occupational Hearing Loss
     - Uses the words "you may age adjust…"

Then, to keep Jerry Maguire happy…a visual representation



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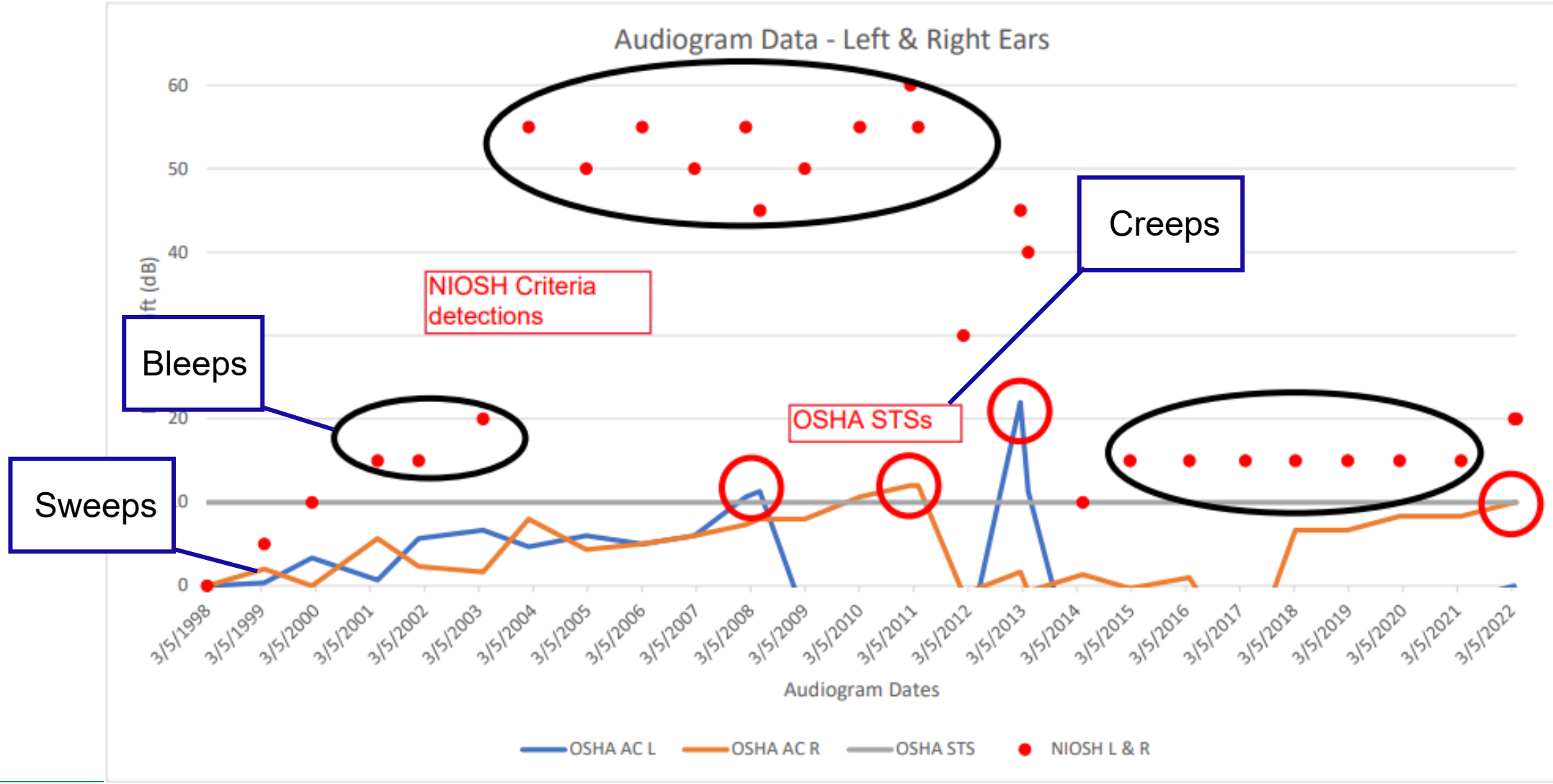
What does it all mean?

What does it all mean?



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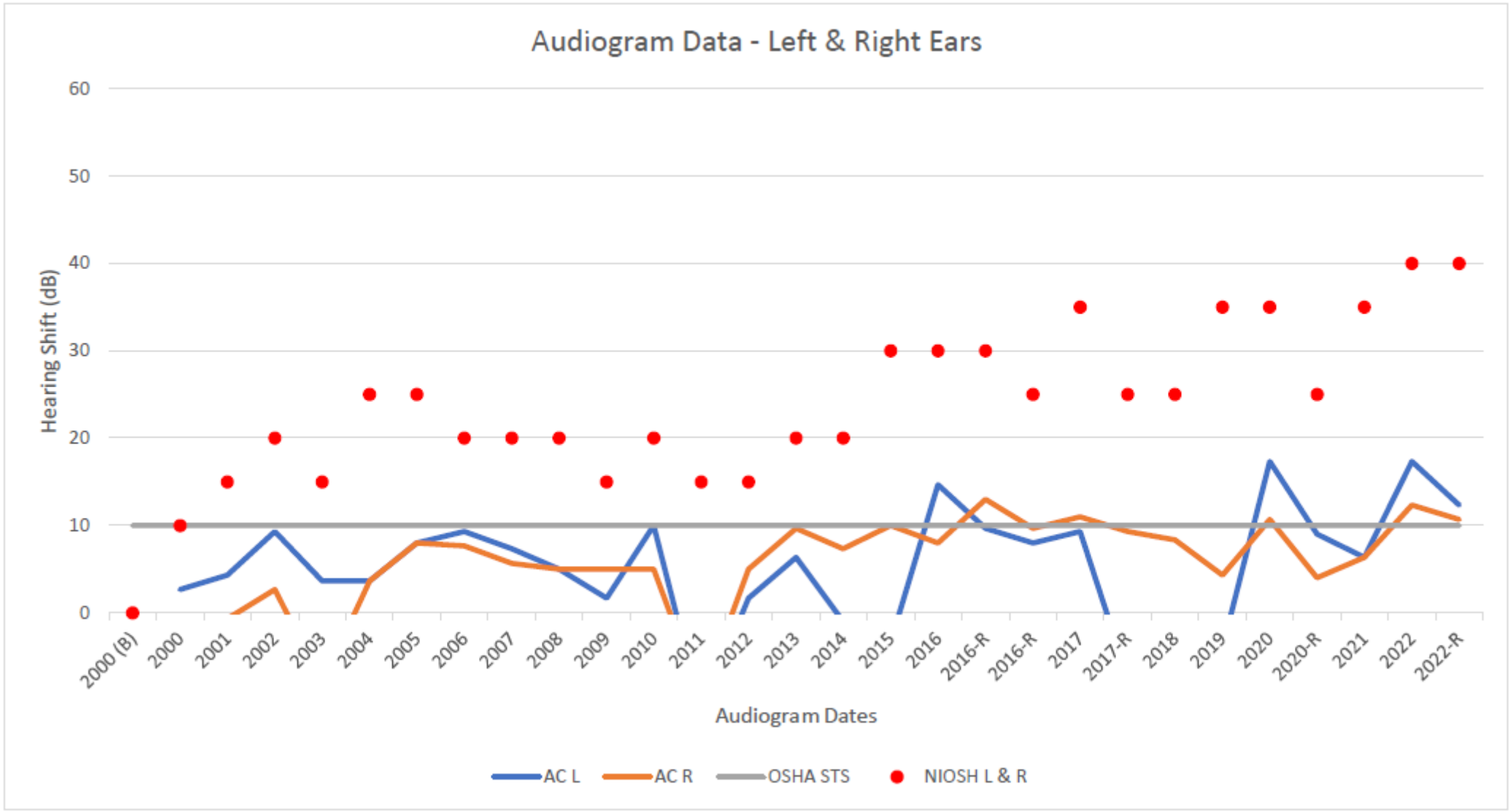
Other examples



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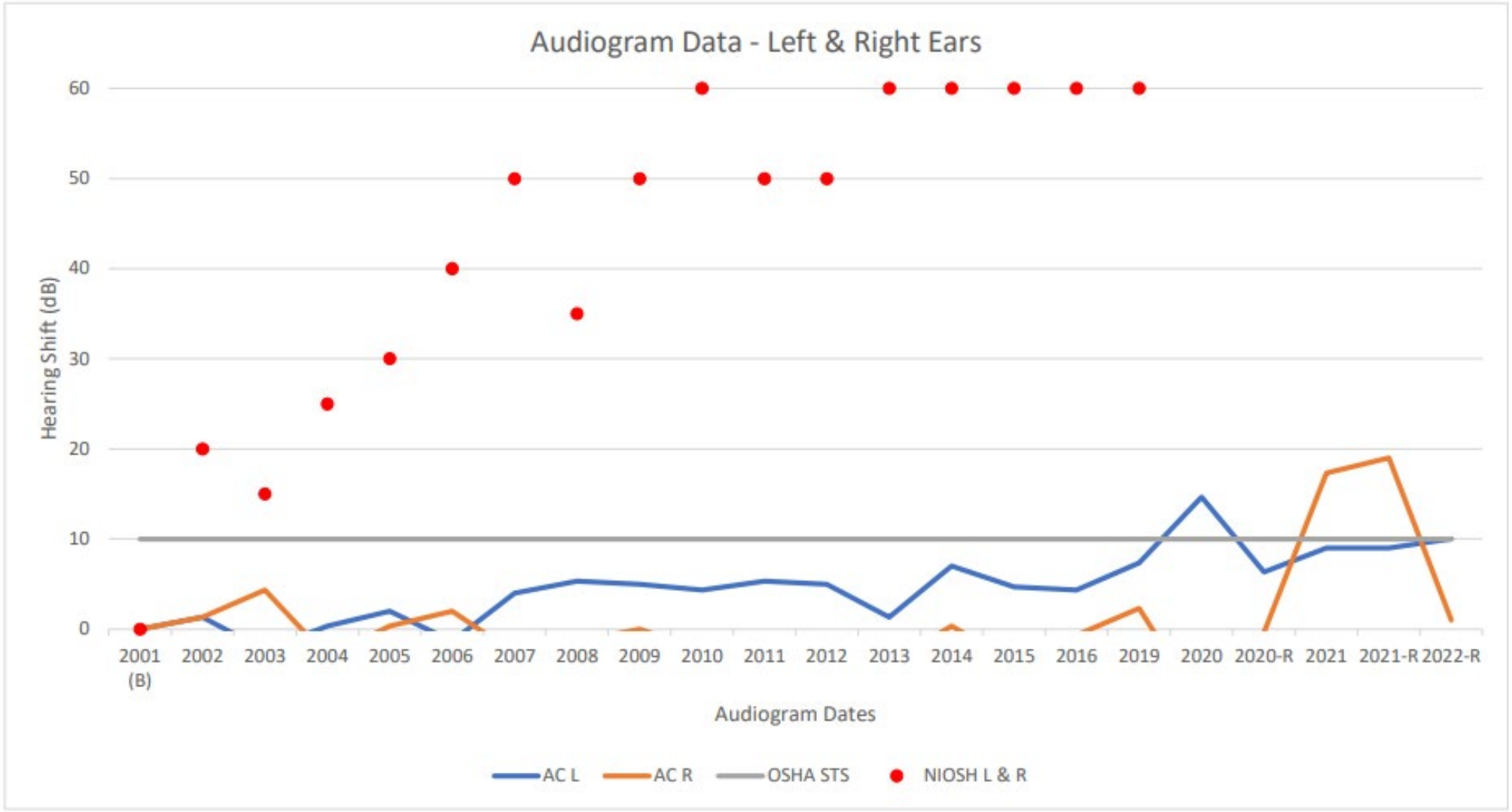
Other examples



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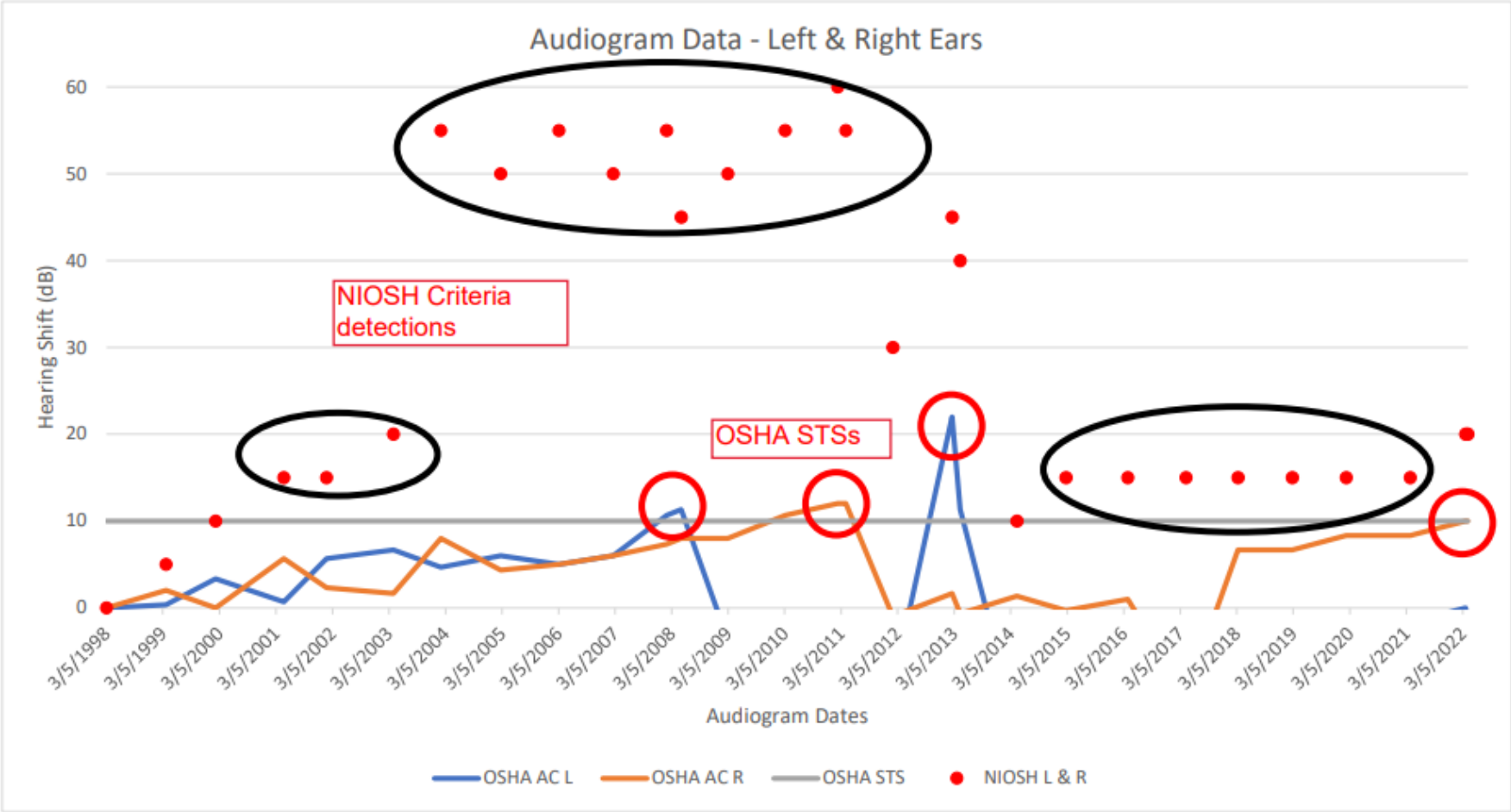
Final Thoughts - Limitations:

- Research limited to a small sample pool.
- Still "negotiating" access to employee records.
- This is NOT focusing on work relatedness – different conversation.
- This is NOT focusing on reportability – different conversation.

Final Thoughts - Observations:

- This exercise supports NIOSH's statement that the OSHA methodology has a lower detection rate.



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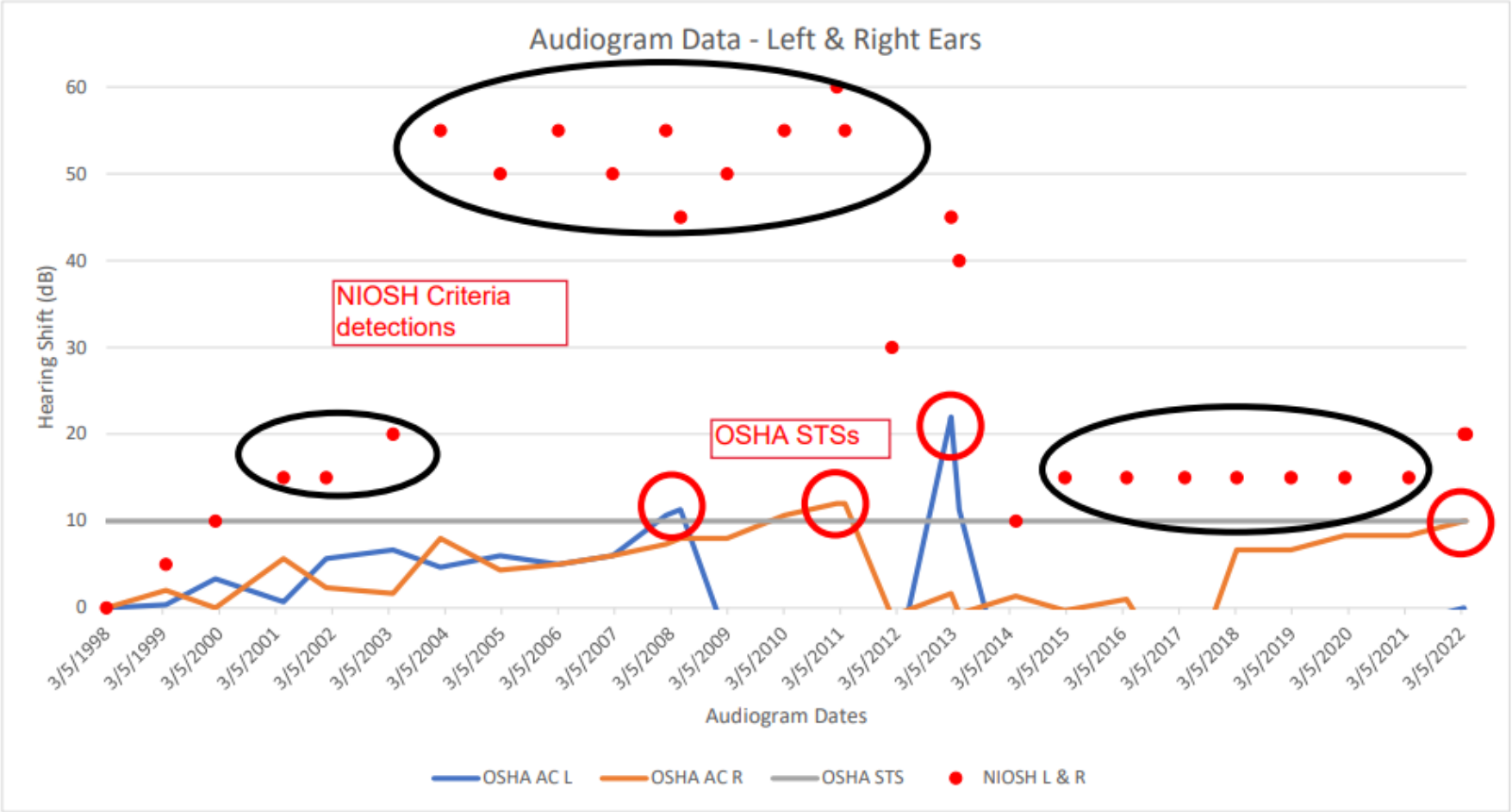
Final Thoughts - Observations:

- The NIOSH method repeated identifies an STS years before the OSHA method.



Final Thoughts - Observations:

- There is some correlation between the NIOSH method and the OSHA non-age corrected method.

	OSHA Shift					NIOSH Shift
)	L	OSHA AC L	R	OSHA AC R	OSHA STS	NIOSH L & R
)	0	0	0	0	10	0
5	1.66667	0.33333	3.33333	2	10	5
)	5	3.33333	1.66667	0	10	10
)	3.33333	0.66667	8.33333	5.66667	10	15
)	8.33333	5.66667	5	2.33333	10	15
)	10	6.66667	5	1.66667	10	20
5	8.33333	4.66667	11.6667	8	10	55
)	10	6	8.33333	4.33333	10	50
5	10	5	10	5	10	55
)	11.6667	6	11.6667	6	10	50
5	16.6667	10.6667	13.3333	7.33333	10	55
5	18.3333	11.3333	15	8	10	45
)	20	-3.6667	15	8	10	50
5	20	-4.3333	18.3333	10.6667	10	55
)	20	-4.6667	20	12	10	60

Final Thoughts - Observations:

- The NIOSH method showed higher frequency hearing loss.

	Left Freq (Hz)						
	500	1000	2000	3000	4000	6000	8000
	5	5	15	30	20	20	15
	5	5	15	30	25	20	20
	5	10	20	30	30	20	20
	5	10	15	35	25	35	25
	5	5	20	35	35	30	20
	0	5	20	40	35	30	35
	10	5	20	35	35	45	40
	20	10	20	40	35	45	40
	10	5	20	40	35	55	45
	5	10	20	40	40	60	40
	10	5	30	40	45	45	55

Questions???


I CAN'T HEAR YOU!
CAN YOU HEAR ME!??
Image by chemSec (INTERNATIONAL CHEMICAL SECRETARIAT)