

# Web-based inspections in industrial radiography

Digital inspections in an analogue world



Statens strålevern  
Norwegian Radiation Protection Authority

[www.nrpa.no](http://www.nrpa.no)

# IAEA-TECDOC-1526 (2007)

TABLE 1. SUGGESTED INSPECTION FREQUENCIES

Use	Inspection Frequency (years)
Dental radiography	5
Nuclear medicine	1-2
Radiotherapy	1
Diagnostic radiology – centres with complex equipment (e.g. computed tomography, interventional radiology, fluoroscopy, mammography)	2-3
Diagnostic radiology – centres with conventional X ray equipment only	3-5
Industrial radiography	1
Irradiators (i.e. industrial)	1
Irradiators (i.e. research)	3-5
Radiation gauges	3-5
Well logging	1-3



# Industrial radiography in Norway



# Solution?



Hire the Flash...



# Solution?



...an army of inspectors...



# Solution?



...use The Internet.



# Method

- Questionnaire sent to radiation protection officers (RPO) by e-mail.
- Unique link in e-mail leads RPOs to their company specific questionnaire online.
- Accompanying letter from NRPA emphasising that responding is obligatory, not voluntary.
- Questionnaire, e-mails, replies handled by EasyResearch™.



# Questionnaire

- 52 questions.
- Questions grouped thematically over 8 pages.
- Multiple choice or specific format to enable automated analysis.
- All questions had to be answered to be able to complete questionnaire.

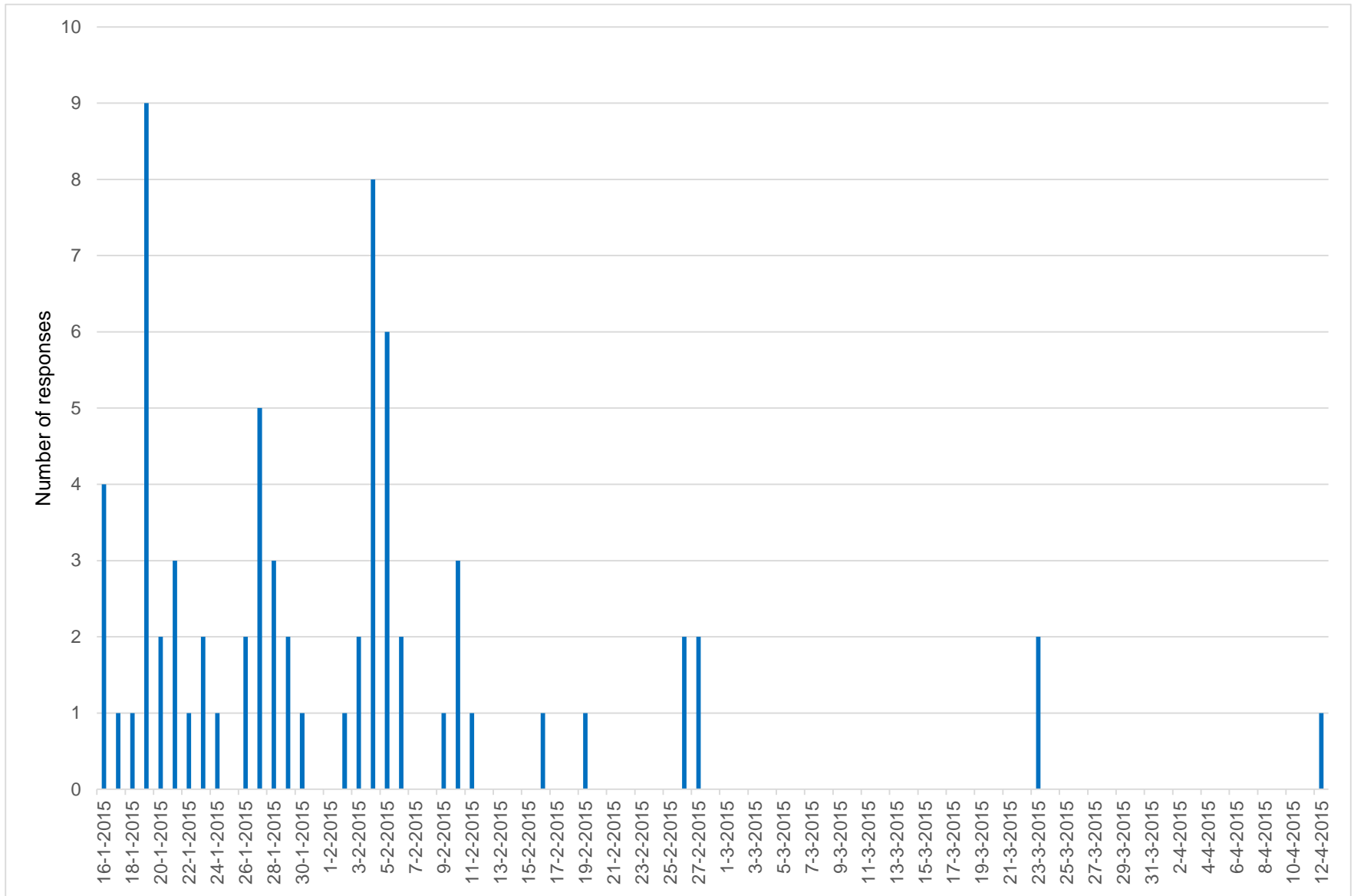


# Questionnaire

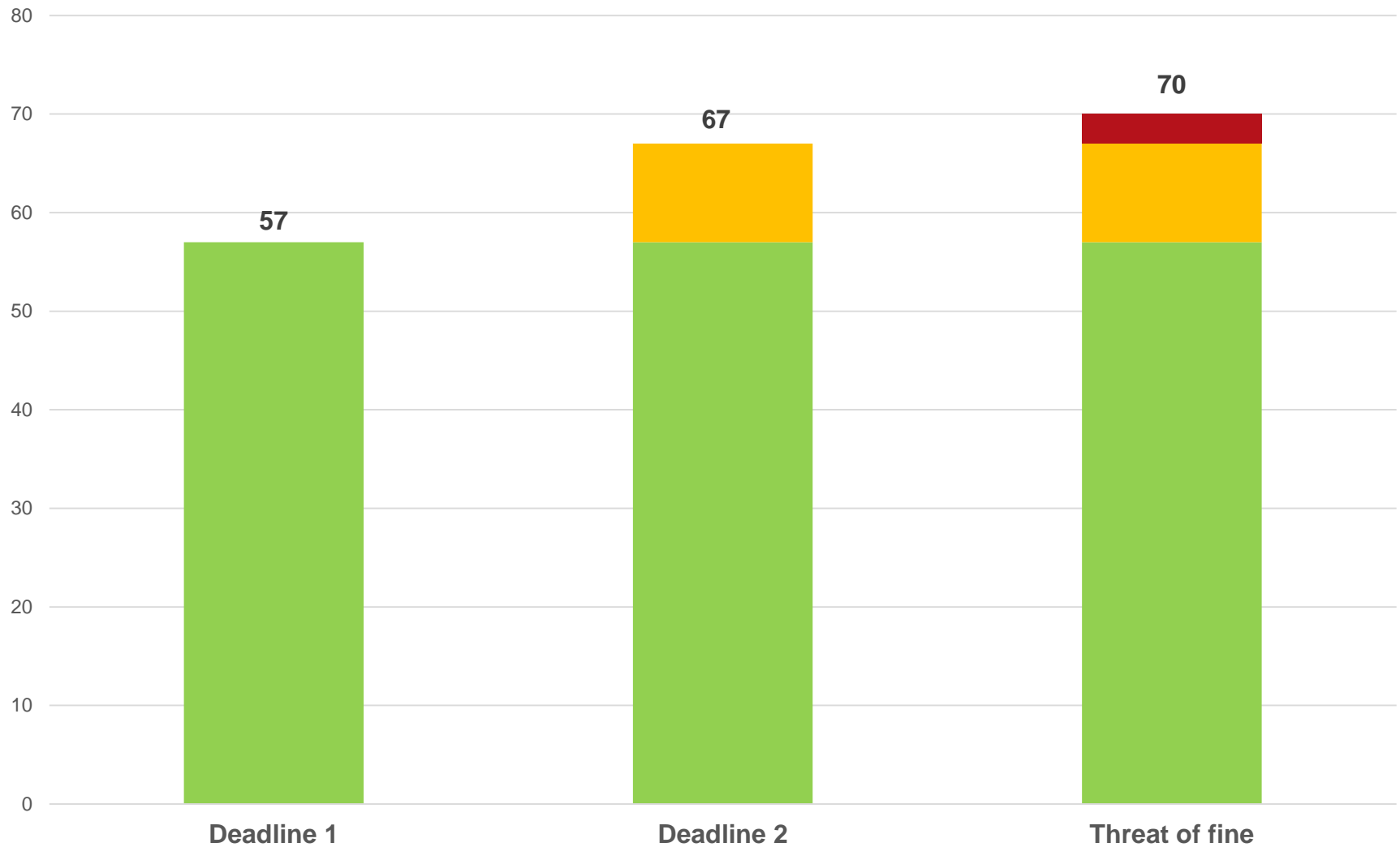
- 8 possible non-compliances.  
("Does there exist written instructions for RPO?")
- 9 possible notifications.  
("What year were instructions for RPO revised?")
- 22 requests for information.  
("Number of devices for gamma radiography?")
- 13 questions regarding substitution.  
("To what extent can UT replace gamma/x-ray?")



# Response timeline



# Response timeline

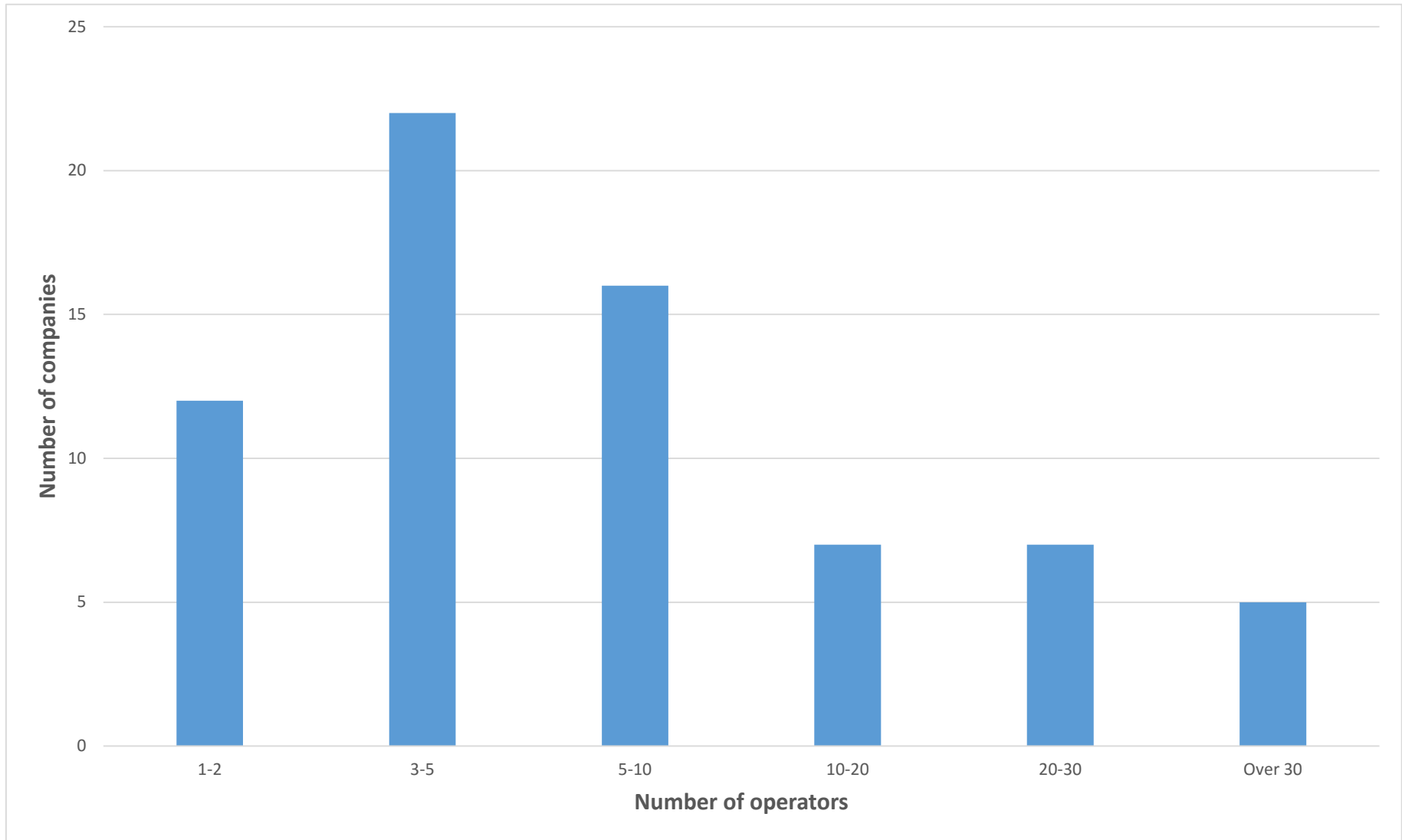


# Results – overview

- 70 questionnaires completed – response rate 100 %.
- Updated information on radiography companies:
  - 928 radiation protection certified operators.
  - 255 gamma sources.
  - 237 x-ray sources.



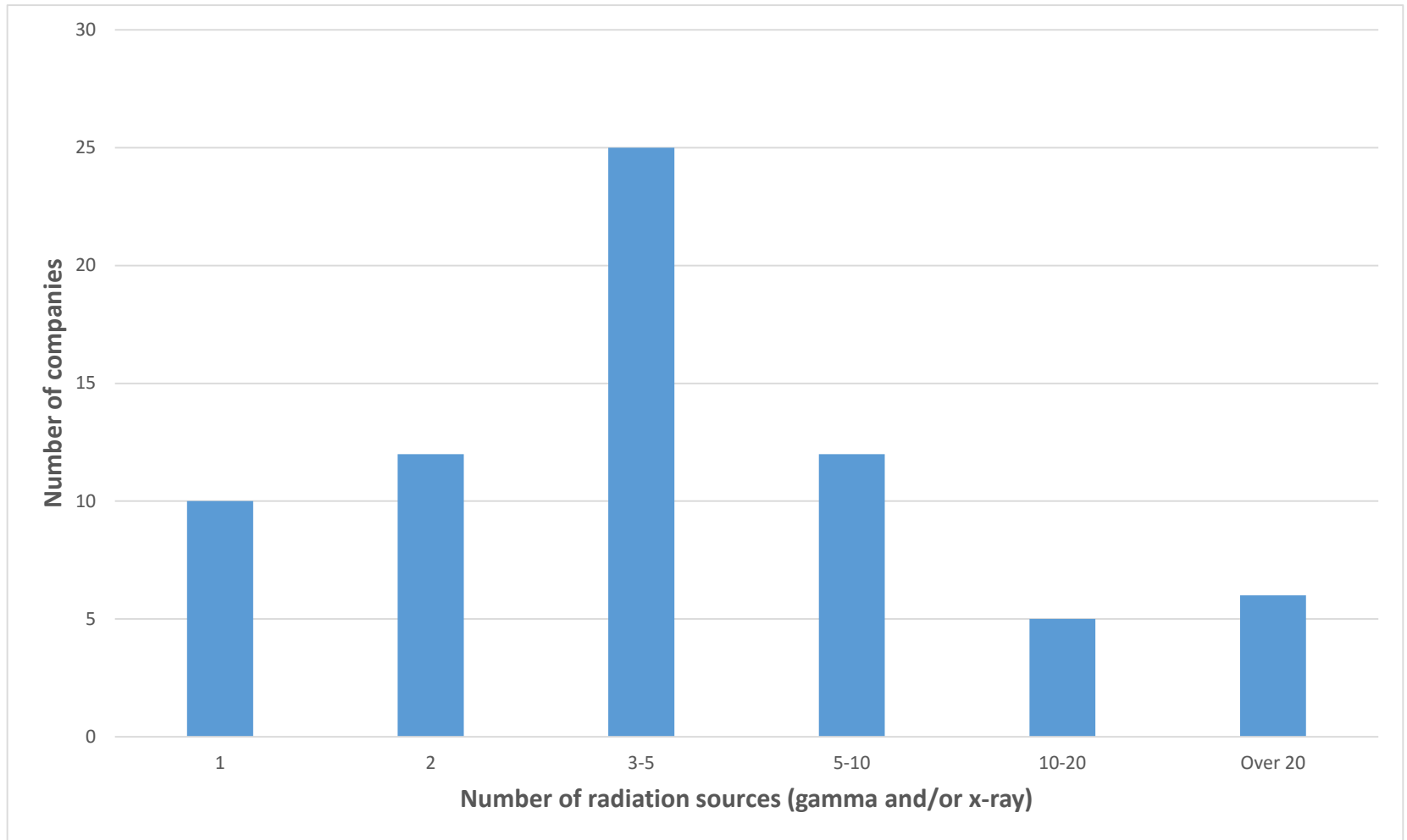
# Results - overview



Number of radiography operators is 10 or less for about two thirds of the companies



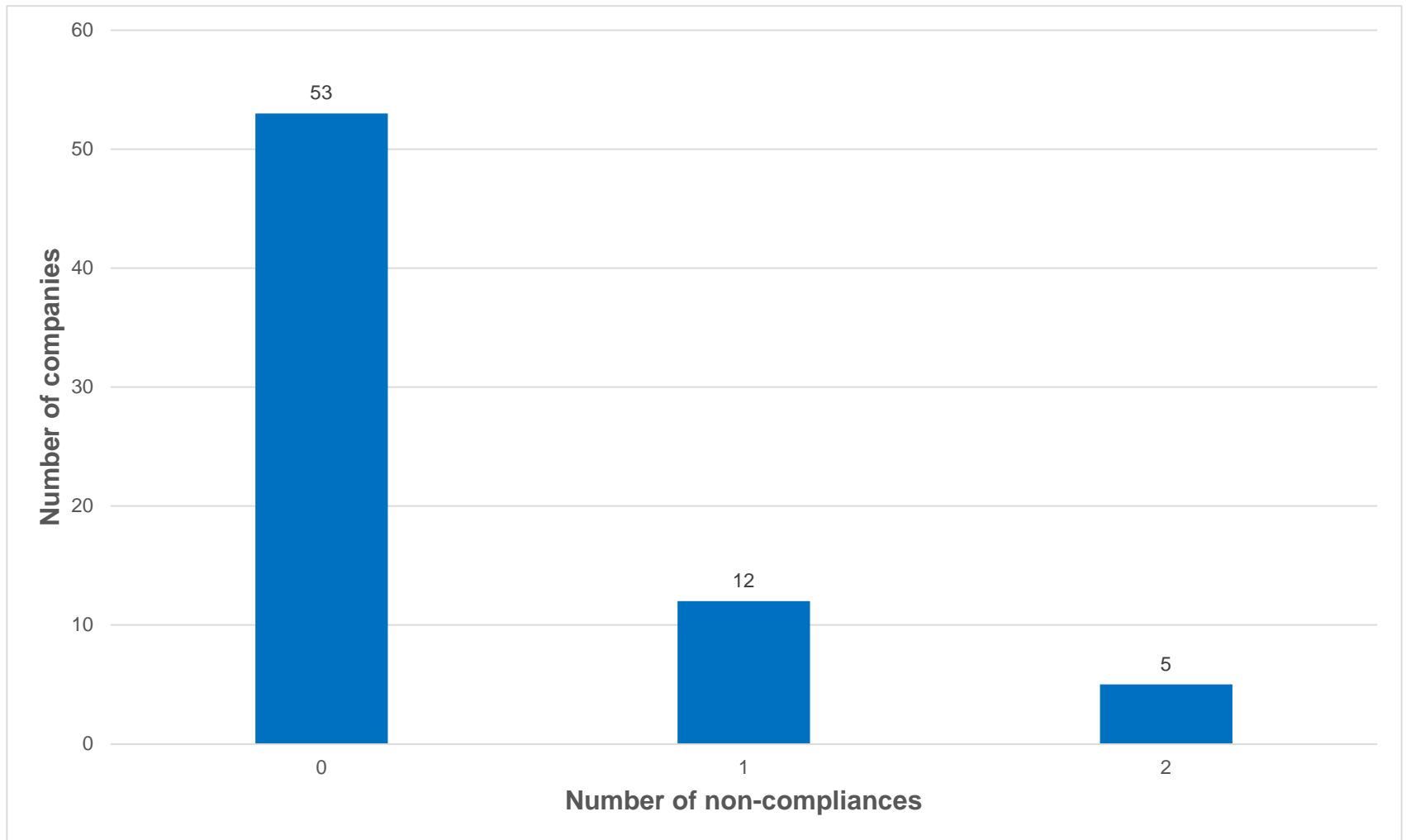
# Results - overview



Number of radiation sources is five or less for about two thirds of the companies.



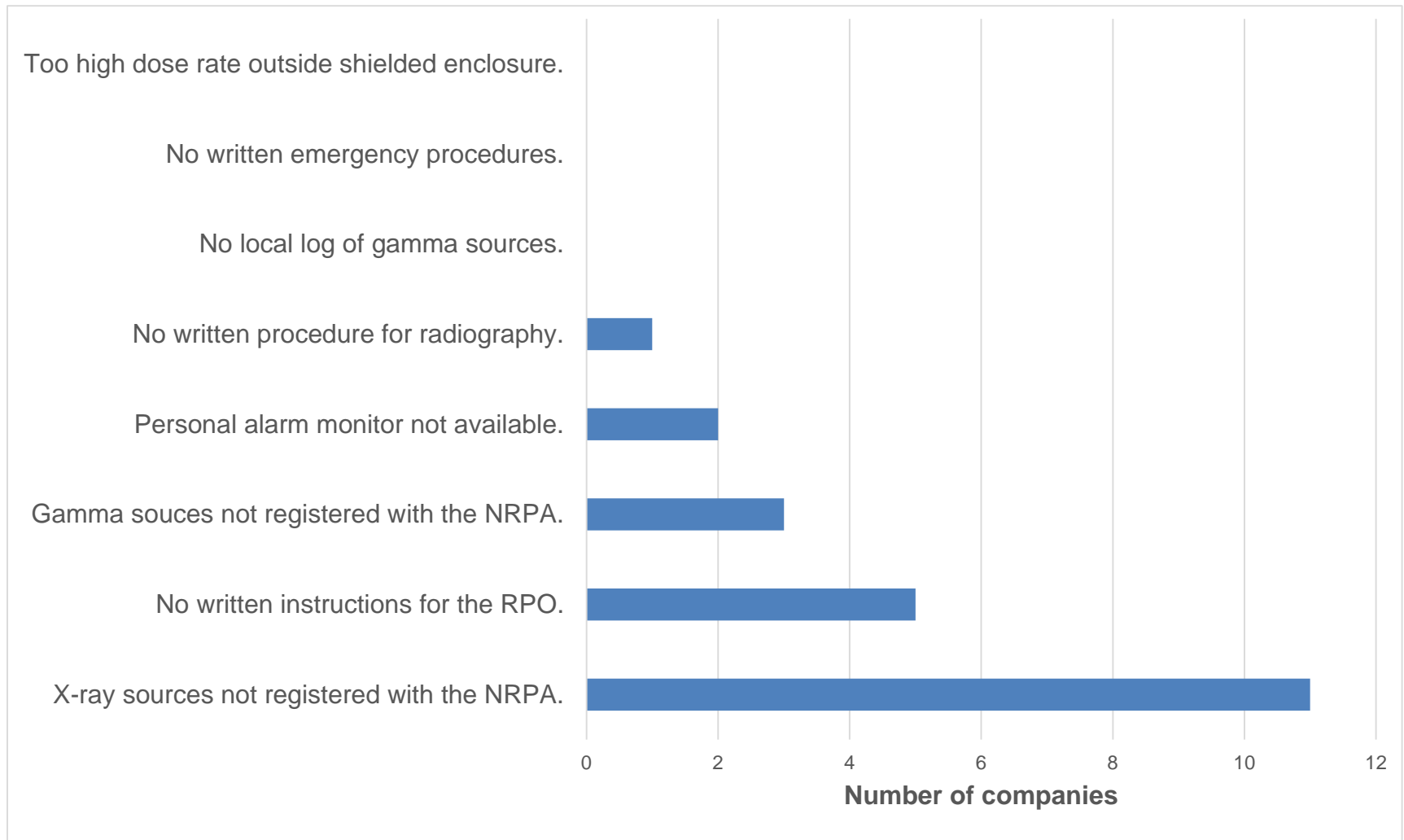
# Non-compliances – distribution



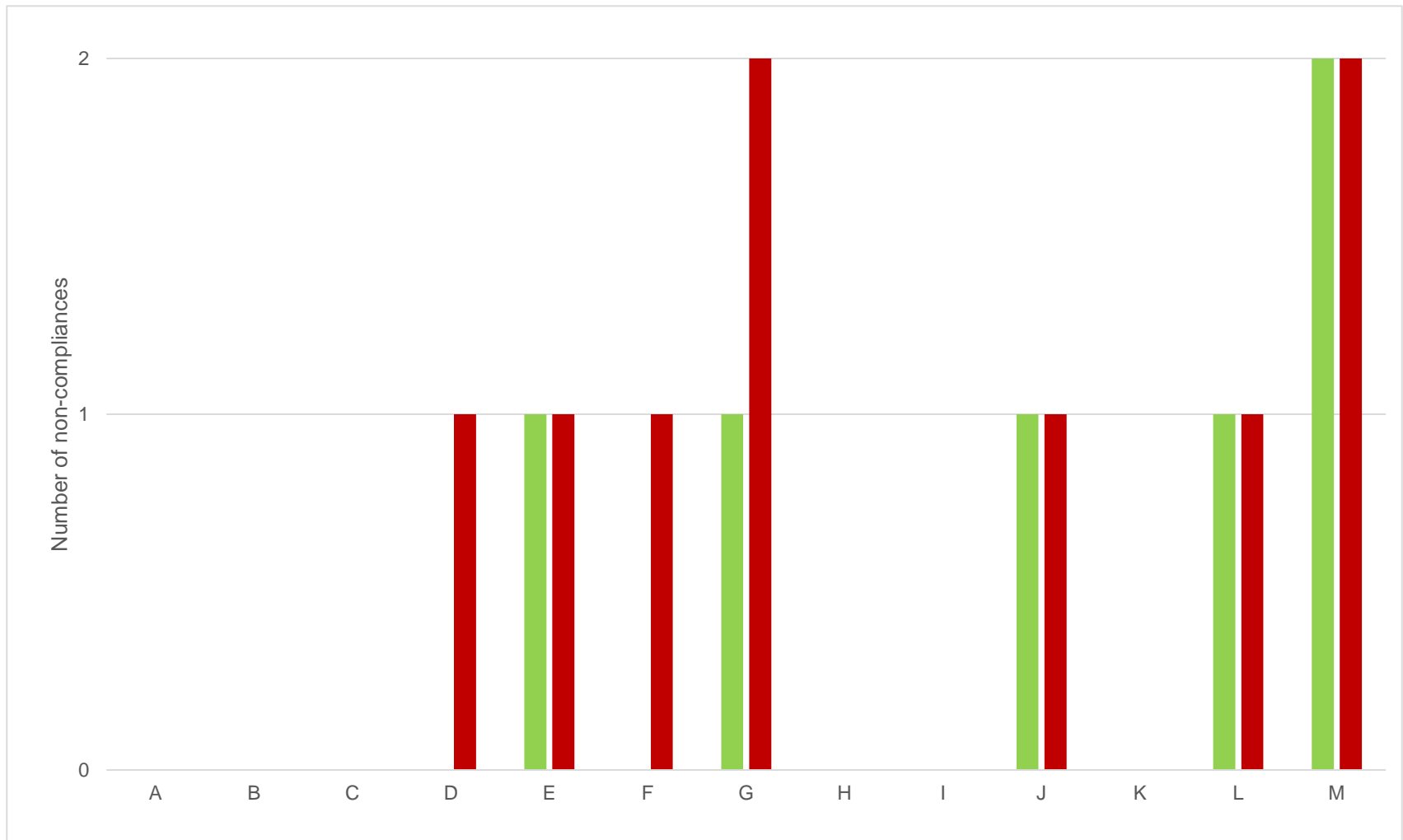
22 non-compliances were found at 17 companies, no company more than two.



# Non-compliances – causes



# Web-based vs on-site inspections



13 companies were subjected to on-site inspections in parallel to the web-based ones. More non-compliances were found on-site, unsurprisingly.



# Web-based vs on-site inspections

- **Company D.**

In questionnaire, they confirmed having written procedures, thus in compliance. On-site these procedures were found sufficiently poor and outdated to warrant a non-compliance.

- **Company F.**

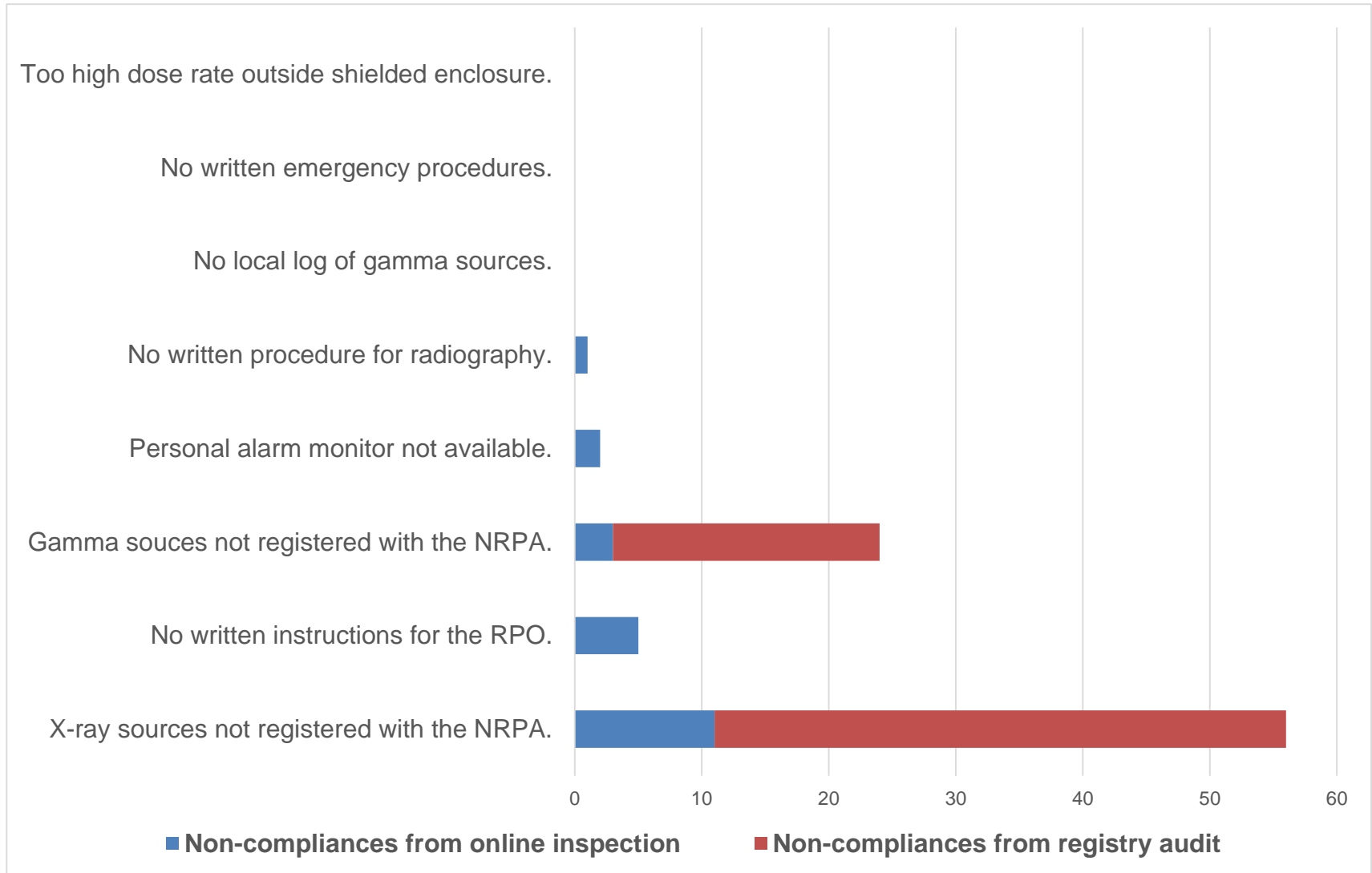
Said in questionnaire that they were using a closed facility for radiography. On-site inspection revealed that this facility did not fulfill all conditions of a closed facility, and a non-compliance was issued.

- **Company G.**

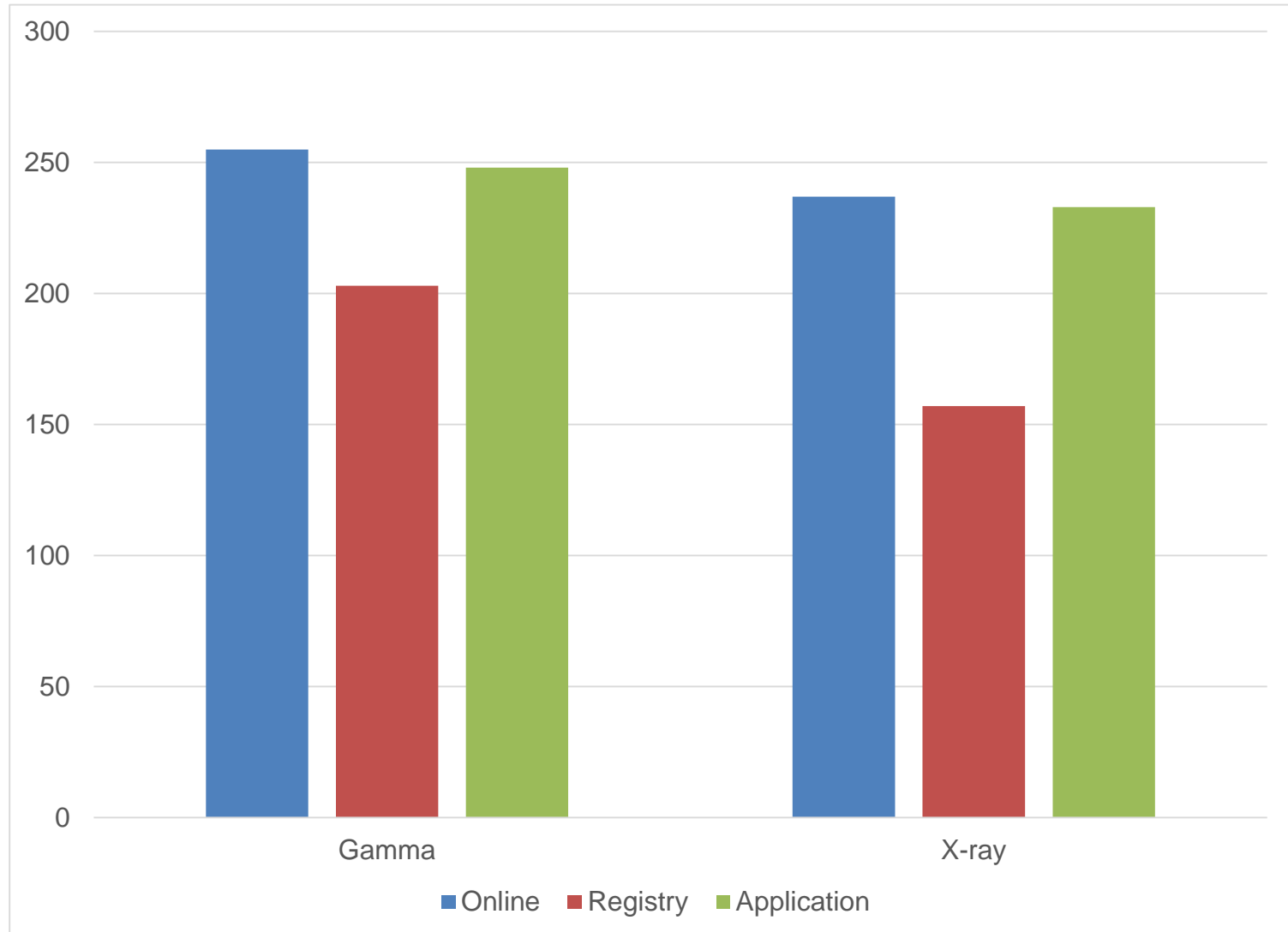
Gave a number of certified operators in questionnaire. Turned out on on-site inspection that one operator did not possess an accredited certificate in radiation protection.



# Self reporting vs NRPA auditing



# Self reporting vs NRPA auditing

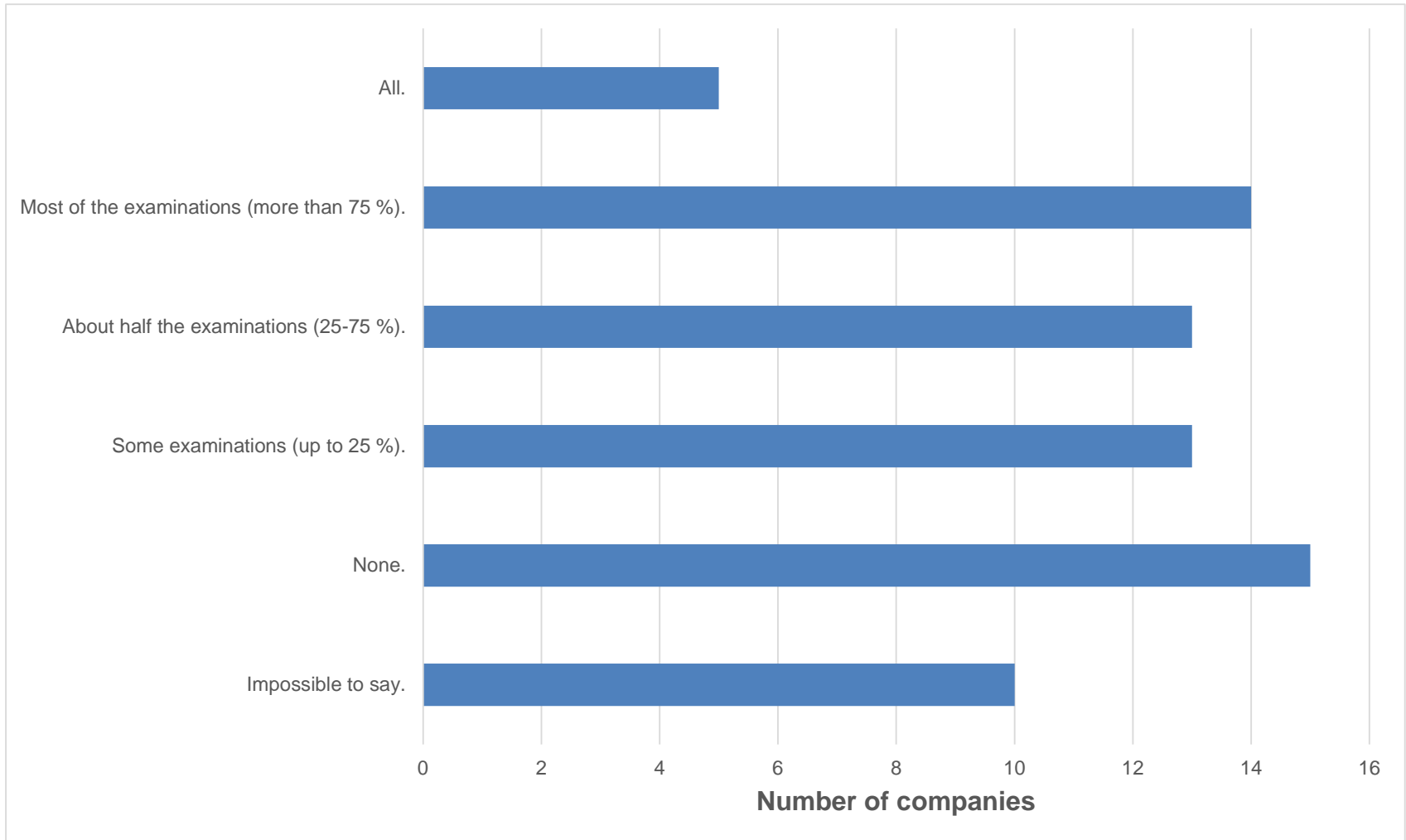


# Substitution

- Question: To what extent can gamma and/or x-ray be replaced by NDT methods which improve radiation protection?
- Six possible substitutions:
  1. X-ray for gamma.
  2. Ultrasound for gamma/x-ray.
  3. Magnetic particle for gamma/x-ray.
  4. Dye penetrant for gamma/x-ray.
  5. Eddy current for gamma/x-ray.
  6. Leakage testing for gamma/x-ray.
- Long story short: Only options 1 & 2 were considered viable.



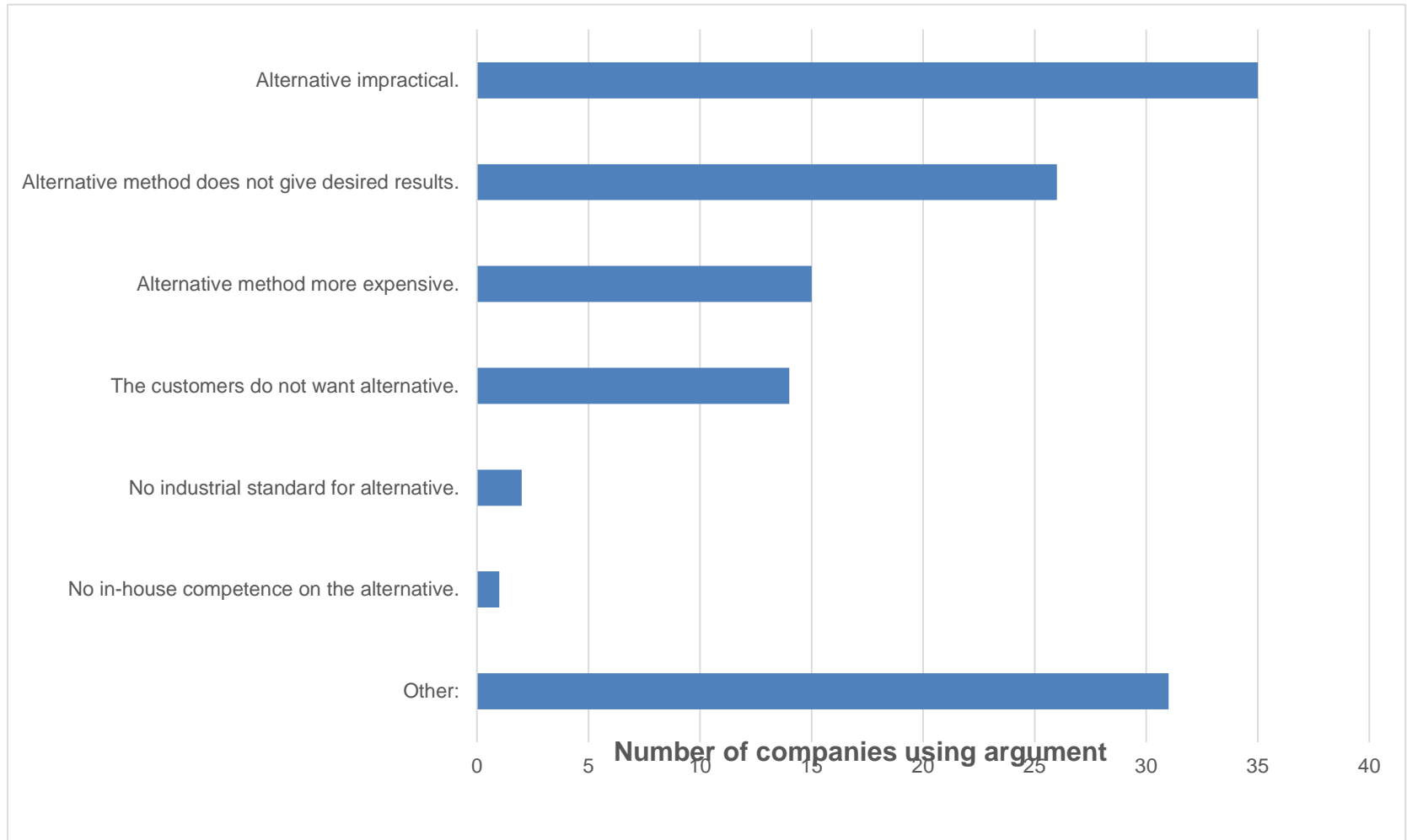
# How many gamma examinations could be performed with x-ray?



About two thirds of the companies (64 %) believe that at least some gammaradiography can be replaced with x-ray radiography.



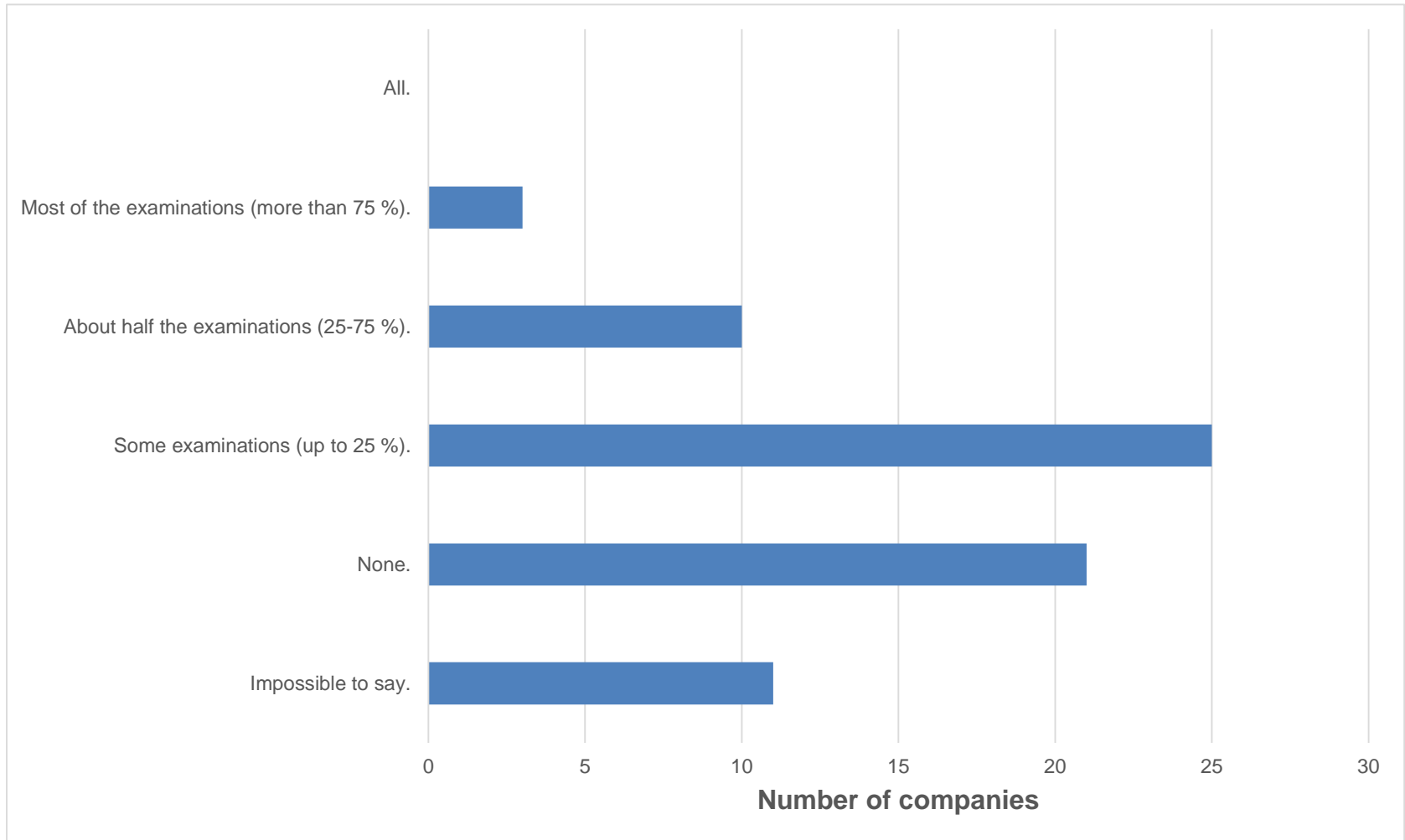
# What prevents x-ray from replacing gamma radiography?



Main argument against x-ray radiography is accessibility for relatively large equipment, poorer image quality and expense for customer (x-ray taking longer).



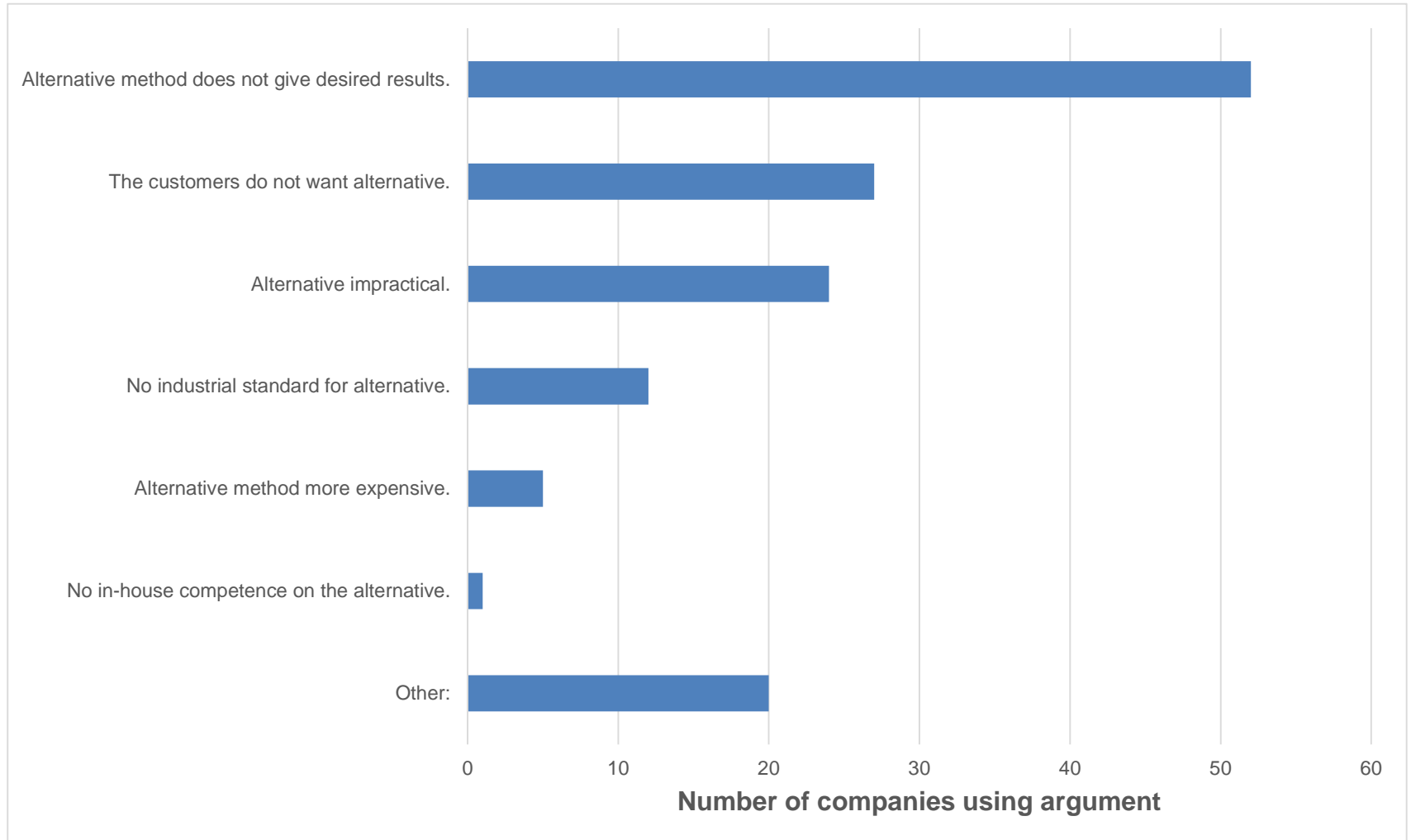
# How many gamma/x-ray examinations could be performed with ultrasound?



About half the companies believe that at least some gamma/x-ray radiography can be replaced with ultrasound.



# What prevents ultrasound from replacing gamma/x-ray radiography?



The main problem with ultrasound replacing ionising radiation is that it cannot be applied in all situations (thickness of objects).

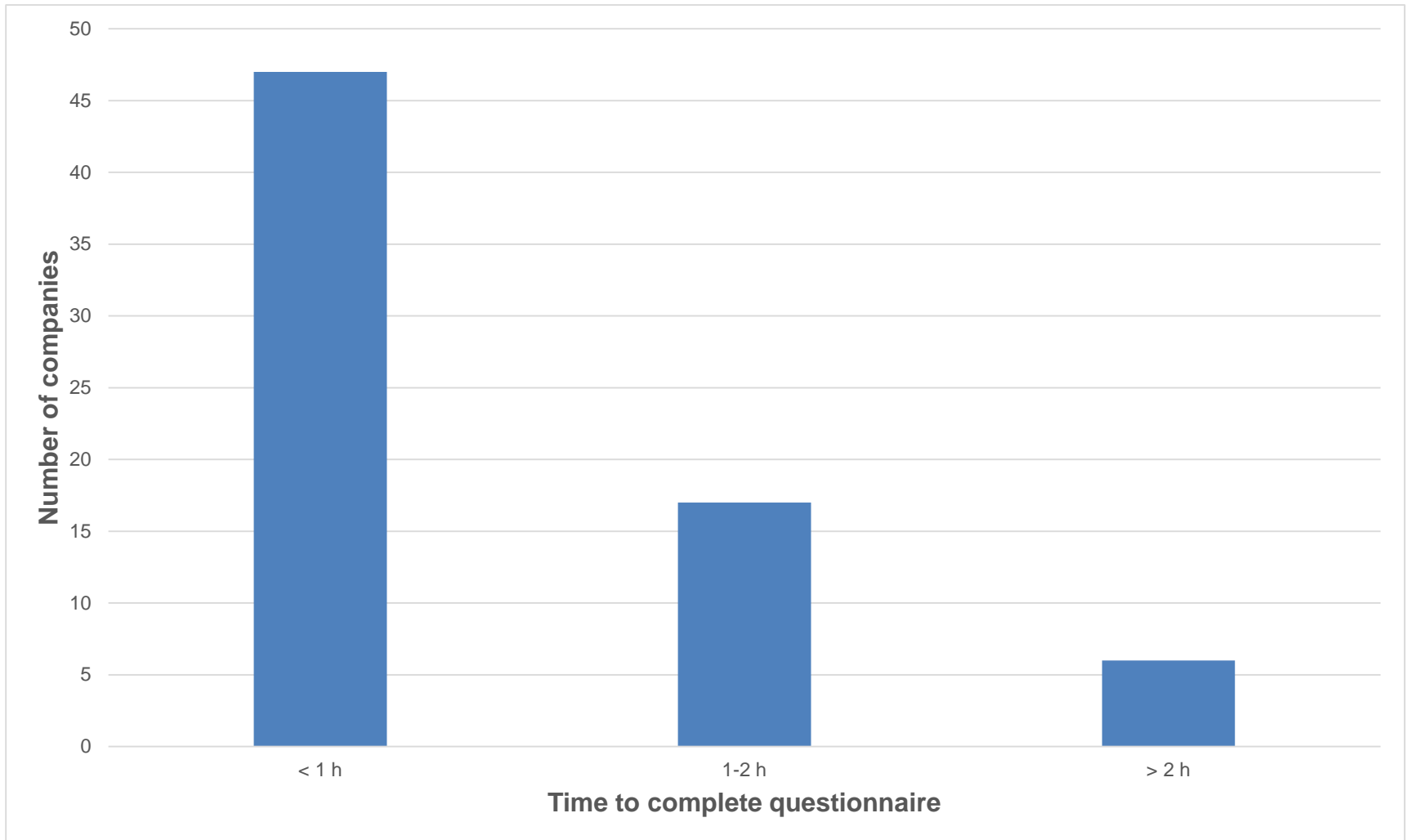


# Substitution «conclusion»?

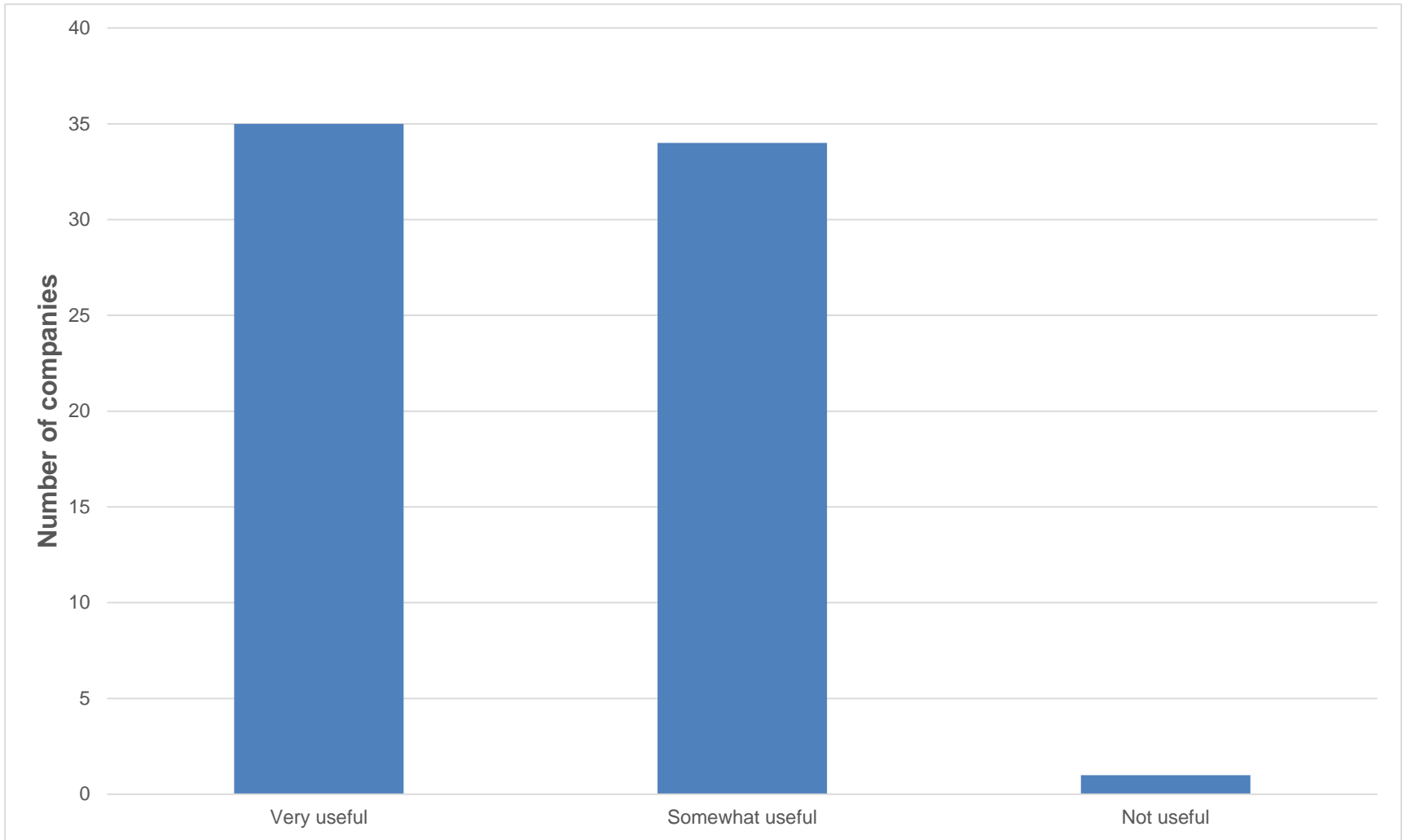
- There is potential for increasing use of x-ray to replace gamma and ultrasound to replace gamma/x-ray, and many companies phase out gamma for their own radiation protection purposes.
- Main obstacles for substitution are accessibility (size of x-ray) and applicability (object dimensions for ultrasound).
- Economical considerations may work against substitution, as x-ray takes longer, making it more expensive for customer.
- Technology developing rapidly, can authorities find incentives to speed substitution up?



# Feedback – time spent



# Feedback - usefulness



# Conclusion

- Web-based inspections feasible – response rate 100 %.
- Much data gathered – quantity over quality.
- Future inspections may:
  - Utilise feature of «conditional questions».
  - Ask for attachment of documents (although currently not a feature in EasyResearch™).
- Method may also be applicable for inspections in other areas (veterinary, dentist, control sources, etc.)

