

Goal setting legislation for the extractive industries – an enabler to innovation and new technologies for controlling mining hazards



Firstly, can I say a sincere **'thank you'** to the organizers of this 18th Annual Safety Seminar for giving me the opportunity to present.

For those here that don't know me, my name is Mark Godden.

I am a relatively new HSE mines inspector, but I have spent my whole career working in the extractives industry, first in quarrying and then in mining.

I am based in southwest England and work out of HSE's Bristol Office.

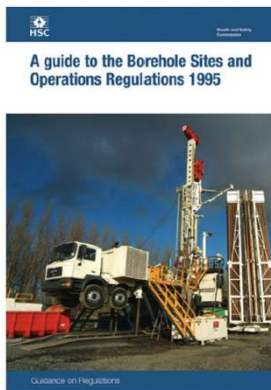
I've stepped in relatively late, to give this presentation on behalf of the Chief Inspector of Mines, Kevin Wilson, who has been extremely busy dealing with other matters.

The title of the presentation is **'Goal setting legislation for the extractive industries – an enabler to innovation and new technologies for controlling mining hazards'**.

In this brief presentation I'd like to discuss how the change from more traditional **'prescriptive legislation'** to modern **'goal setting legislation'** provides in-built flexibility to the operators of mineral extraction sites, who wish to take advantage of new and emerging technologies.

I'd then like to look at the Mines Regulations in a little more detail and finally talk about some of the issues that we find whilst undertaking inspections.

Goal setting legislation for the extractive industries – an enabler to innovation and new technologies for controlling mining hazards



Anybody who has read them will quickly realise that there is much common ground between the **Borehole sites and Operations Regulations**, the **Quarries Regulations** and the **Mines Regulations**.

These are all good examples of **'goal setting legislation'**.

There are many similarities, including the definitions of **'operator'**, **'assessment'**, **'health and safety document'**, **'competence'**, **'asset integrity'** and **'maintenance management'**.

Several common themes run through these regulations, beginning with the requirement to undertake **risk assessments** and then identify and implement suitable **risk controls**, as part of an overarching system to manage health, safety and employee competence.

Workplaces in the extractive industries are all different, with different challenges and hence different risk profiles.

'One-size-fits-all' – **prescriptive** - legislation could be seen as restrictive and inefficient in these circumstances.

Goal setting legislation allows duty holders to effectively tailor mitigations to address the mix of hazards that are particular to their workplace.

Goal setting legislation **facilitates innovation** by being sufficiently flexible to allow duty holders to dynamically develop bespoke safety management systems - in-line with any technological changes that they may wish to introduce - whilst still mitigating risks to people and remaining in compliance with the law.

HSE inspectors responsible for regulating the extractive industries will continue to focus on major hazards - in-line with the HSE major hazard regulatory model.

HSE's Enforcement Policy Statement

PROTECTING PEOPLE
AND PLACES FOR **50** YEARS  HSE

“As a regulator, we use a wide variety of methods to encourage and support business to manage health and safety risks in a sensible and proportionate way and secure compliance with the law.

In making these decisions, we will have regard to economic growth and the impact that our actions are likely to have on businesses”.



Enforcement Policy
Statement

HSE's guiding principles are contained in its **Enforcement Policy Statement**.

Amongst other things, this policy requires that all regulatory actions must have regard to **economic growth** and the impact that our actions are likely to have on **business**.

This is favourable to innovation and to the introduction of new technologies into the mining and quarrying sectors.

As mines inspectors we are increasingly finding ourselves working to support other sectors - in the move towards **net zero**.

This includes providing input related to:

- Both on-shore and off-shore wind farms.
- Battery energy storage systems.
- Civil tunnelling.

PROTECTING PEOPLE
AND PLACES HSE

Enable industry to innovate safely to prevent major incidents, supporting the move towards net zero

- Safe transition to a carbon-neutral economy
- With innovation comes potential high risk
- Help industry respond to new technologies and hazards
- Ensure regulatory framework is fit for purpose



HSE's ten-year strategy will enable industry to **innovate safely**, to prevent major incidents, supporting the move towards net zero.

Transitioning to a carbon neutral economy will see the emergence of more innovative technologies and processes.

These will present new risks.

We will work to make sure that health and safety legislation doesn't preclude innovation and progress.

We will contribute towards enabling a safe transition across industry sectors.

To help manage risk, we will focus our attention on the breadth of activities that net zero encompasses.

Innovation and new technologies



We are seeing a rapid uptake of new technology in mining.

This includes:

- The use of drones for surveying, 3D scanning and stability monitoring.
- The use of IT for monitoring, maintenance and defect management systems.
- The use of relatively low-cost networked seismographs to monitor ground movements.
- The use of relatively low-cost networked, fixed laser-based measuring devices to continuously monitor structural changes in mine geometry.
- IP based communications equipment with the benefit of man-down alerts and person tracking, which could be life-saving during an emergency.
- The use of computer modelling and artificial intelligence, to develop production strategies, ventilation strategies and support strategies.
- The development of strategies to permit the winding of men and minerals in the same shaft using independent winders.
- Battery powered equipment - from front-end loaders to electric drills and angle grinders.
- The use of thermal imaging equipment in mines rescue.
- The world leading innovations that we have seen rolled out for the on-going development of Woodsmith Mine in North Yorkshire.

- The innovative and environmentally important water treatment plant at South Crofty Mine in Cornwall.

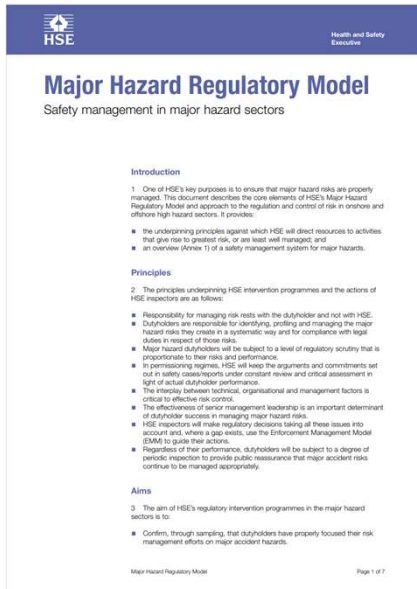
Many of these innovations would have required exemptions under previous legislation.

Goal setting legislation, based upon risk assessment can be used to enable innovation by identifying **risks** and implementing suitable and sufficient **risk control measures**.

Risk assessment can be used to demonstrate an equivalent or improved risk control against previous or existing standards.

The role of the HSE Inspectors is to challenge the suitability and sufficiency of those risk assessments, including assumptions and subjective decisions made as part of producing those assessments.

HSE Major Hazard Regulatory Model



- Ensure that major hazard risks are properly managed
- SMS is underpinned by key principles linking together the technical, organizational and management aspects of risk
- Contains the core elements of the Mines Inspectorate approach to the regulation and control of risk in mines

All stakeholders need 'assurance' that major hazards are being adequately controlled.

How does the Company Board assure itself that major hazard risks in its business are under control?

Risk creators require appropriate:

- Workplace cultures.
- Safety management systems.
- Properly designed and well-maintained plant and equipment.
- Competent staff.
- Major hazard safety performance indicators.
- Other individual H&S metrics.

Major hazard safety is a **priority** for HSE.

It is not enough to simply have designed and implemented a mine safety management system.

Duty holders need to collect and act on information that shows the system is working and is delivering effective control of risk.

Duty holders need to be sure that they are not operating **blind**, hoping and believing that everything is fine but without **knowing** - because they are not properly monitoring and controlling their risk mitigation measures.

The **major hazard regulatory model** has changed the way that the mines inspectorate works.

We have been using this approach since the introduction of the Mines Regulations in 2015.

We believe that this has resulted in a general improvement in the understanding of risk, by industry.

We have been expanding this approach into quarries.

Mine operators are really surprised:

- **When what should have happened - didn't happen.**
- **When what shouldn't have happened - did happen.**
- **When people get seriously injured and/or their mine suffers significant losses.**

Questions that every duty holder should be asking themselves are:

- Do you know what your **major hazard** risks are?
- Do you know what your main **vulnerabilities** are?
- What are you **doing** about these ?
- How concerned are you about the **level** of risk?
- How confident are you that your safety management systems are **performing** as they should?
- Are you **measuring** and **monitoring** the right things?
- Do you seek out the "**bad news**" as well as the good?

The Mines Regulations 2014 (MR14)

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The Mines Regulations 2014

➤ **Gone** - 48 sets of mining specific Acts

Guidance on Regulations



This is a free-to-download, web-friendly version of L149 (first edition, published 2015).

ISBN 978 0 7176 6647 8

The Mines Regulations 2014 came into force on 6 April 2015 and replace all previous mines-specific health and safety legislation.

This publication provides practical advice and guidance on what you have to do to comply with the Mines Regulations 2014. It also directs the reader to other general health and safety regulations that apply at mines and gives additional guidance where appropriate.

L149 (first edition)
Published 2015

It is particularly relevant to mine operators but will also be useful to others within the mining industry such as mine managers, safety representatives and representatives of employee safety; any employer with employees who work below ground at mines; and self-employed contractors working below ground at mines.

➤ **Gone** - Around 1000 Sections & regulations

➤ **Reduced** to 76 regulations in MR14

I'd now like to discuss the Mines Regulations 2014 (MR14) in a little more detail.

MR14 replaced:

- **48 sets of mining specific Acts.**
- **Approximately 1000 Sections and regulations.**

All these individual pieces of mainly '**prescriptive**' legislation were reduced to just 76 '**goal setting**' regulations in MR14.

This made the regulatory requirements around mining, easier to comprehend by duty holders - and by virtue of that - easier to comply with.

MR14 also took the responsibility for health and safety management away from the **mine manager** and placed this where it belongs, with the **mine operator** – who controls the finances.

MR14 Borrowed heavily from previous Regulations applicable to mines - but uses a structure based on the Quarries Regulations 1999.

L149 is the associated guidance to MR14.

Risk assessment

- Suitable and sufficient
- Identify hazard
- Risk
- Control measures
- Level of competence
- Review



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Suitable and sufficient **risk assessment** underpins all health, safety and competence management - particularly in a goal setting regulatory environment.

Risk assessment is a fundamental building block for all risk identification and control.

Those who create the risk, should **understand, control** and **manage** that risk.

Risk assessment is a tool which must be used when introducing innovation and new technology.

Duty holders need to understand, manage and review the **effects of change** - including any new risks, introduced because of such changes.

New risks will also need to be **identified** and **controlled**.

The Mines Regulations, Regulation 9, requires the preparation of a Health and safety document.

This document must demonstrate that the **risks** to which persons at the mine are exposed have been assessed in accordance with regulation 3 of the Management Regulations.

Many formats for risk assessment have been developed over the years.

Some of these formats are too simplistic to be effective in a major hazard mining environment - especially when there are few control measures detailed beyond "**operator training**".

It is always easiest to blame the operator!

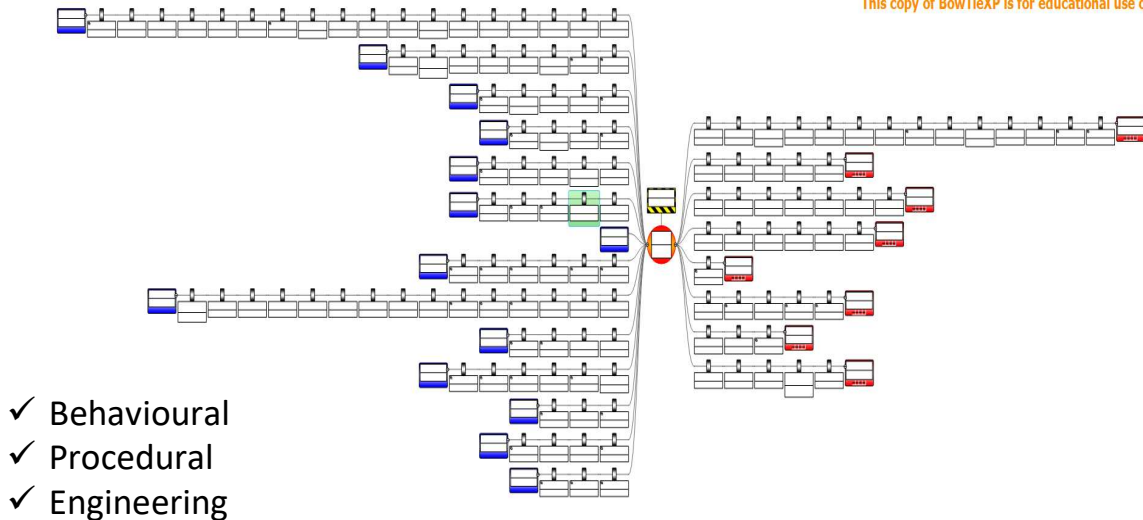
Risk assessment processes are often described as being "**based on historical events and experience to date**", this approach opens the potential that that hazards which have not yet occurred - **could be missed**.

Risk assessments also need to capture the “**what ifs**”.

This is why we encourage use of **bow-tie** risk assessments, compiled with the involvement of frontline personnel, to capture the detail.

Major Hazards - Bow Tie Example

This copy of BowTieXP is for educational use only



A **Bowtie Risk Assessment** is a risk management technique that is used to analyse and visualize potential threats, consequences, and control measures related to a specific major hazard.

- A box representing a **Loss of control** sits in the middle of the bowtie.
- **Preventive** barriers (to the left) are in place to stop a loss of control.
- **Mitigation** barriers (to the right) are in place to reduce the severity of the potential outcome, should a loss of control occur.

Bowtie risk assessments provide an overview and are typically used in conjunction with conventional written risk assessments that apply detail to the individual preventive and mitigation barriers.

Barriers can be classified as either '**behavioural**', '**procedural**' or '**engineering**'.

Duty holders should always aim to have at least one **engineering barrier** in each line to failure.

Critical barriers are those whose failure would lead to an immediate and unstoppable loss of control (i.e. the winding rope snaps).

Critical barriers should always be identified as those which need the most maintenance and attention to keep them in place and fit-for-purpose.

Critical barriers can often be used to develop effective **safety performance indicators or SPIs**.

Many of us have been through the journey of developing major hazard bowties for our individual sites.

The first time that I encountered a bowtie I was confused to say the least and I admit that it took a while before I began to appreciate the benefits.

Enlightenment has shown me just what a useful tool they can be for managing risks in a major hazard environment.

Safety Performance Indicators (SPIs)

Major hazard SPIs are what senior managers should use to make major hazard decisions

Research shows that most senior managers have:

- An overwhelming belief in the effectiveness of their system designs and controls
- Limited sense of risk control system vulnerability and degradation
- Limited means of discovering degradation in the control of major hazard risks short of catastrophe



Developing process safety indicators

A step-by-step guide for chemical and major hazard industries



This is a free-to-download, web-friendly version of HSG254 (First edition, published 2006). This version has been adapted for online use from HSE's current printed version.

You can buy the book at www.hsebooks.co.uk and most good bookshops.

ISBN 978 0 7176 6180 0

Price £11.95

The guidance is aimed at senior managers and safety professionals within major hazard organisations that wish to develop performance indicators to give improved assurance that major hazard risks are under control. It is assumed that companies using this guide already have appropriate safety management systems, so the emphasis is on checking whether their risk controls are effective and operating as intended. The guide draws on good practice in the UK chemical sector.

Too many organisations rely heavily on failure data to monitor performance, so improvements or changes are only determined after something has gone wrong. Discovering weaknesses in control systems by having a major incident is too late and too costly. Early warning of dangerous deterioration within critical systems provides an opportunity to avoid major incidents. Knowing that process risks are effectively controlled has a clear link with business efficiency, as several indicators can be used to show plant availability and optimised operating conditions.

While aimed mainly at major hazard organisations, the generic model for establishing a performance measurement system described in this guide will also apply to other enterprises requiring a high level of assurance that systems and procedures continue to operate as intended.

SPIs are measurable data points used to assess and monitor the effectiveness of safety measures within an organization or industry. They help track safety performance over time and identify areas for improvement.

SPIs can be divided into two types:

1. Leading indicators – These are proactive measures that help predict and prevent accidents before they occur.

Examples are:

1. Number of safety training sessions conducted.
2. Frequency of inspections.
3. Near-miss reports.

2. Lagging indicators – These are reactive measures that evaluate past incidents and their impact.

Examples are:

1. Number of workplace injuries.
2. Lost-time injury rates.
3. Equipment failure statistics.

Why are SPIs important?:

1. They help organizations make data-driven safety decisions.
2. They can be used to identify trends and potential risks.
3. They support regulatory compliance.
4. They enhance overall workplace safety culture.

HSG 254 '**Developing process safety indicators**' is a freely downloadable HSE publication that provides more detail on the development of SPIs in major hazard organisations.

Experience gained whilst undertaking interventions across the sector shows us that SPIs are an area which generally, still needs further development.

As inspectors, we use SPIs to reassure ourselves that a duty holder's safety critical barriers are in place and working.

Duty holders should be doing the same.

Inspection delivery guides - Mines

- Ground control
- Prevention of inrush
- Explosion prevention
- Fire prevention
- Explosives
- Mass transport
- Asset integrity
- Shafts and winding
- Surface structures
- Electrical power systems
- Control and instrumentation systems
- Tips
- Escape and rescue
- Ionising radiation
- RCS



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Inspection delivery guides have been produced by the mines' inspectorate, covering the major mining hazards.

For example – asset integrity – which covers the life cycle of **assets** from **specification** through **procurement, commissioning, maintenance** to end of life **decommissioning**.

The guides are made available to duty holders and are used by mines inspectors to guide the course of major hazard interventions.

Our inspection delivery guides are **dynamic 'live documents'** and as such they are subject to regular **review** and **update**, to take into consideration our recent findings, as well as any relevant feedback from mine operators.

In this way the guides are **adaptable** to **change** and **innovation** - for example, the shafts and winding inspection delivery guide had to be reviewed following practical developments in that sector.

Inspection delivery guides help to:

1. Clarify expectations.
2. Provide consistency.
3. Identify risk-based priorities.
4. Support proportionate regulation.
5. Improve compliance and safety standards.

Sector SMS issues

- Approach to risk reduction not prioritised by risk assessment
- Limited consideration of human factors in risk assessments
- Inspection and maintenance resources not allocated based on risk assessment
- Inadequate participation of front-line workers in the development of risk assessments and operating procedures
- Lack of targeted SPIs at appropriate organizational levels
- Limited processes for SMS audit and review
- Roles and responsibilities not defined for risk control barriers
- Persons responsible for risk control barriers and SPI's not covered by a competency management system

Some common **safety management system** issues, that we find within the mining sector - includes:

The approach to **risk reduction** is not necessarily prioritised by **risk assessment**.

Human factors in risk assessments could sometimes be given more consideration.

- Further consideration could be given to workforce morale, thermal environments, the management of shift work, overtime, an ageing workforce and fatigue.
- There can sometimes be an over-reliance on human performance as a control measure - with limited **human reliability analysis** and **evaluation**.

Inspection and maintenance resources should be prioritised on risk.

- We sometimes see the excessive scrutiny of relatively compliant procedures rather than the higher risk activities.

Risk assessments and **operating procedures** could often be made more effective with the involvement of and input from **front-line workers**.

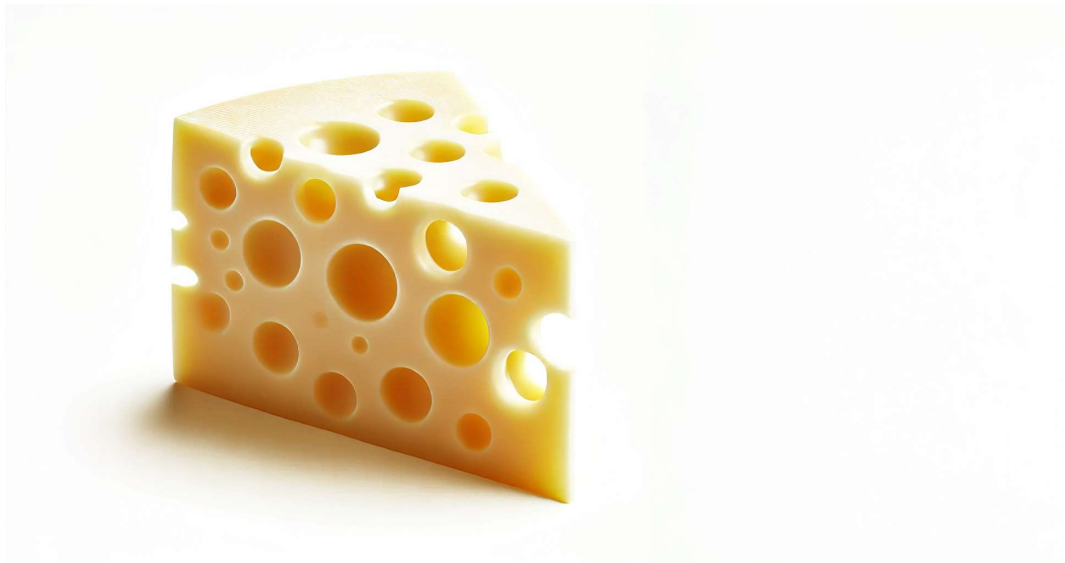
There can be a lack of **targeted** SPIs at the appropriate organisational levels.

Established processes are sometimes not fully in place for safety management system **audit** and **review**.

Roles and responsibilities are not always fully **defined**, for those who maintain risk control barriers.

The persons who are responsible for overseeing risk control barriers and SPI's are occasionally not themselves, being covered by a **competency management system**.

- It is worth remembering that the competency management system should apply **equally** to the **whole** of an organisation's organogram - not just the **lower half**.



Duty holders should:

- Develop a full set of **standards**, as appropriate - for a comprehensive competency management system.
- Develop clear **procedures** and methods that detail all the tasks needed to effectively operate their competency management system.
- Carry out a **gap analysis** to identify any **holes** in their **competency** and **safety** management systems and then develop effective mitigations to **fill** these holes before anything goes **catastrophically wrong**.

It is not all bad news - we do see many good examples, where duty holders have developed effective safety management systems.

Risk control issues in mining



The Mines Regulations 2014

Guidance on Regulations



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- Geotechnical
- Explosives
- Vehicles and transport rules
- Isolation procedures and permits to work
- Emergency / escape and rescue arrangements

Competent **geotechnical** input is necessary for effective ground control, which is vital to mining.

We sometimes see gaps between the recommendations contained within reports and what happens in practice.

Reviews should always be undertaken if things change.

Geotechnical input is also critical to ensure the long-term stability of tips.

The Tips Act 1969 came as a direct consequence of Aberfan.

It's worth reminding ourselves that the Mines Regulations also cover tips, including stockpiles and lagoons.

In Wales, the Senedd are looking to introduce a new Bill to address concerns about disused tips and any potential instability due to climate change.

Short duration, high intensity rainfall events can have a detrimental effect on the stability of tips.

The safe use and transport of **explosives** is another mining activity, with risks that demand high levels of competency from those involved.

We need to properly assess the risks resulting from changes in blasting technology, such as:

New explosive types.

New mixing and shothole loading systems.

New initiation systems – such as wireless detonators.

Vehicles are a high-risk area in mining.

18% of workplace fatalities in the UK during 2024 involved someone being struck by a moving vehicle.

This is a worldwide issue.

We often see large pieces of plant operating in areas where pedestrians could be present.

Good pedestrian / vehicle segregation is vital - as is vehicle maintenance, the use of seatbelts and brake testing.

Isolation procedures based on LOTOTO need to be in place and to always be used.

Remember- LOTOTO does not only apply to electricity – it is also very relevant to hydraulic systems.

We continue to investigate areas where **isolation failures** have caused accidents.

In situations where a loss of confinement of hydraulic fluids could cause something to move with the risk of entrapment, machinery should always be adequately propped or chocked before any maintenance work takes place.

Hydraulic machinery should always be checked after maintenance work, to ensure that it is operating correctly and as expected, before it is put back to work.

It is easy to reverse a couple of hoses with the potentially catastrophic result - that a control works backwards.

Permits to work for higher risk and/or complex tasks should also be normal practice.

Inspections need to cover the condition and integrity of **machinery guarding**. It is not enough to note that a guard is in place, guards must be in good condition, of good construction and be of adequate strength.

Adequate **emergency** arrangements that are proportionate to the risks, also need to be in place, along with a viable second means of egress from the areas in a mine where people work.

The failure to prevent a major hazard incident is **unacceptable** - but the failure to provide effective contingency arrangements in the event of a major hazard accident is **unforgivable**.

Thank you for listening...



Many thanks for listening.

Does anyone have any questions?