

CCS 技术通告

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关于 IACS 发布“人为因素问题处理指南”（Rec. 192）的技术通告

一、背景

国际船级社协会（IACS）于 2025 年 9 月发布了“人为因素问题处理指南”（Rec. 192），该建议案旨在指导 IACS 及航运业其他组织在制定文件时，系统性地考虑复杂、多维度的人为因素问题。

二、主要内容

Rec. 192 建议案引入以人为本的方法，纠正将 ISM 规则视为解决人为因素方案的误区，主张从源头通过“消除”和“替代”风险来实现本质安全。建议在文件制定的早期阶段，从船上和岸上工作量、决策、生活和工作环境以及操作和维护四个方面识别人为因素考虑因素，并利用风险控制层级理念，基于在设计阶段预判并消除风险的原则，聚焦于可能实施的高级风险控制措施，制定具有设计安全和防故障特性的要求，从而减少船舶和航运公司对额外知识储备、培训和引入新的或修改流程和程序的需求。

本通告已在本社网站（www.ccs.org.cn）上发布，并由各分社转发所辖区域内的各有关单位。如有任何疑问，请与科信处（ti@ccs.org.cn）联系。

附件： 1. IACS Rec. 192 - 人为因素问题处理指南

2. IACS Rec.192 Guidelines to Address Human Element Issues

*以英文为准，中文翻译供参考。

第 192 号建议书：人为因素问题处理指南

(2025 年 9 月)

1. 目的

1.1 本指南的目的是为 IACS 工作组在制定决议和建议案时如何考虑复杂、多维度的人为因素问题提供信息。本指南亦可供航运业其他组织（以下简称用户）制定类似文件（规则、公约、标准，以下简称输出文件）时使用。使用本指南文末的表 1 可确保用户持续考虑并识别输出文件中的任何人为因素影响。在制定输出文件时可迭代使用表 1 以减轻和/或控制所有已识别的影响。

2. 背景

2.1 航运业人为因素问题的考虑长期以来被 IMO 视为一个重要方面。根据 IMO 决议 A.947 (23)《本组织人为因素的愿景、原则和目标》中定义的原则，人为因素是一个多维度的复杂问题，其影响到海上安全、安保和海上环境保护，涉及到船员、岸基管理人员、监管机构、经认可组织、船厂、立法机构及其他相关方开展的各类人为活动，各方均需协同配合，以有效处理人为因素问题。

2.2 安全，包括本质安全设计，取决于对理解对人员的期望要求以及他们是否可以满足这些期望，无论是解读输出文件，使用为满足输出文件要求而设计的布置、设备或程序进行工作时，还是在应对（或处于）可通过输出文件的要求予以减轻的失效或合理可预见事件时。

2.3 考虑危险应意识到可能有替代方式处理这些问题，这些方式在有效性上有所不同。用户应争取制定能在设计阶段消除或减小危险的输出文件。

2.4 以人为本的方法，考虑如何最大程度利用人员能力，弥补人的弱点，以及预见人员造成风险，应作为所有全面考虑对人为因素的影响以及来自人为因素的影响的输出文件的起点。

2.5 人为因素问题分析是一个整体过程，应包括多方面因素，诸如人为表现和动机、健康和安全、职能分配、工作和工作场所设计、过往经验借鉴、新型且不熟悉的技术在船舶系统的应用，最终使设计安全并制定防故障要求。

3. 以人为本的方法

3.1 本指南的主要目标之一是引入以人为本的方法并促其在制定航运业输出文件时成为人为因素问题影响分析中的关键因素。

3.2 以人为本的方法认为人员给系统带来的主要特征之一是目标意识和行动意识。当目标被理解，就有可能开始设计一个系统来促进它的实现。

3.3 以人为本的方法把考虑人员带给系统的人的属性作为其中心点。重点在于强调人员互动的积极影响，减少负面影响。

3.4 以人为本的方法代表设计方看待工作场景中人员职责的重大转变。它利用人员的灵活性，支持人员学习的能力，并弥补其生理（和其他）“弱点”。

3.5 任务是设计一种足以支持的环境促进这种弥补行为，即：从人出发进行设计。

3.6 在设计安全、可靠和可持续的系统时，人为因素要求考虑诸多因素，ISO 将实现这一目标的方法定义为“以人为本的设计”。

3.7 考虑人体工程学准则以及人员能力和局限性的做法通常被称为“人为因素工程”。

4. IACS 活动对人为因素的影响

4.1 在早期阶段识别以下影响至关重要：人员产生的影响；对操作、应用、安保、维护人员、任何输出文件相关人员的影响；以及任何新的输出文件对整体安全、安保和环境方面的影响。

4.2 一个普遍的误解是认为 ISM 规则是 IMO 对人为因素的解决方法。但是，IMO 文件的范围超过 ISM 规则。人为因素/人类工程学的健康和安全管理方法确实接近 ISM 规则，但人为因素/人类工程学是用来最大限度地提高人类的表现，其与“安全 2”概念的下列方面十分契合：

1. 识别输出文件拟处理的主要危险；
2. 使用控制层级识别消除或减少已识别的危险的可行措施；
3. 通过使用检查表，更好、更精确地处理与人为因素相关的危害。

4.3 这个方法与“以人为本”的方法是并行不悖的，“以人为本”的方法明确了人员在系统的操作和安全方面的目的，以及他们以安全方式开展操作所需要的支持，这可概括为：“工作、危险、人员、工作环境”。

5. 人为因素问题的评估

5.1 引言

由输出文件的制定和后续执行产生的人为因素问题评估应由制定输出文件的用户开展。

IACS 活动对人为因素的影响是考虑以下两个方面的过程：

由于下列因素产生的系统对人的影响：

- 新的或经修订的个人任务和组织要求
- 新的或经修订的操作；
- 新的或经修订的技术；
- 新的或经修订的维护要求；
- 新的或经修订的知识和培训要求。

由于下列因素产生的人对系统的影响：

- 过多的工作量、疲劳和压力；
- 沟通和组织不充分；
- 知识和培训不充足。

在输出文件制定的早期阶段，使用以人为本的方法，适当评估对人为因素问题的影响的，可使用户识别对船员、岸基管理人员、管理机构、被认可组织、船厂、立法者和其他各有关方的所有人为活动造成的可能影响，所有各方都需要相互合作来有效处理人为因素的问题。

对人为因素问题的评估是一个创造性活动且应考虑下列两个步骤：

- 识别人为因素考虑因素
- 识别危险控制措施

对人为因素问题的评估应与输出文件的完整范围和目的相关联。

这包括:

- 正在进行的工作,
- 所涉及人员的数量、位置和角色,
- 船舶(或其他实体的)布置,
- 操作程序和事件或活动的持续时间(这可以是连续的、间歇的或非正常状态)。

建议使用两种技术协助开展关于人为因素问题的创造性思考,即“使用背景分析”和“批判性检查”。

“使用背景分析”围绕以下标题审查使用程序、布置或设备的情况:

- 用户-用户类型、二级或间接用户、技能和知识、相关资质、相关技能、物理属性、动机(正面或负面)、工作特性
- 任务特性-目标、活动、选择、任务输出,执行任务产生的副作用或风险,任务频率、任务持续时间&任务灵活性、物质和精神需求、任务依赖性、关联的任务、安全或环境问题、任务输出的关键程度
- 资源-可重复使用资源、不可重复使用的资源
- 环境-技术环境、物理环境、社会、文化和组织环境

“批判性检查”是6个基本问题的名称:

- 要做什么?
- 在哪里做?
- 谁来做?
- 活动的顺序是什么?
- 为何是这种方式?
- 其他还能做什么?

航运业中的输出文件包括设计、工程、材料和结构以及当下控制。每项工作都有不同的人为因素考虑因素。典型的如下:

- 对船体结构而言,用户是船级结构和设计部门。读者如何使用内容、可读性如何、如何解释、程序的组织匹配性。
- 对于机械和设备,问题将会是“对于系统而言“安全”意味什么”,理解人员会遇到什么情况以及他们需要做什么。
- 对于材料,主要考虑的是在生命周期全阶段管理材料特性的影响、质量控制/管理能力/检查/分析。
- 对于程序,包括我们的程序和我们所要求的程序,考虑因素将会是程序的适用范围以及适用主体。
- 文件/输出将涉及新的和复杂的技术,这些技术会带来新的人体工程学问题。这些新技术大多数严重依赖 ICT(信息和计算机技术)或在其中执行。这些系统的可用性/用户体验将是其安全操作的重要部分并且每个目标领域各不相同。

5.2 人为因素考虑因素的识别

IMO 已经为现代航运安全选取了一系列最重要的考虑因素,并且将清单减少至5个标题下的33个考虑因素(参考:MSC-MEPC.1/Circ.5/Rev.4 通函,附件5)。IMO 建议在制定新的决议和建议案的第一步是在下列领域识别人为因素考虑因素:

1. 船上和岸上工作量
2. 决策
3. 生活和工作环境
4. 操作和维护
5. 处理人为因素的措施

表 1 中提供了记录考虑因素和结果行为的清单。图 1 显示了应用清单所遵循的流程。

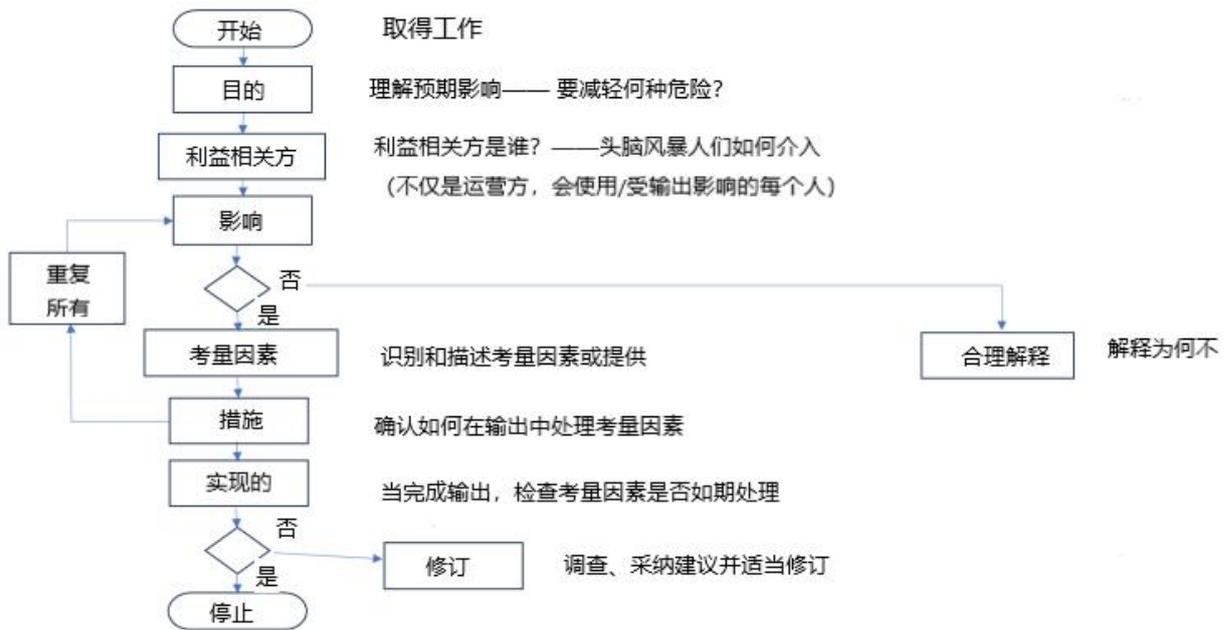


图 1 制定决议和建议案时人为因素考虑流程

下列分节详细解释了人为因素考虑因素

5.2.1 船上和岸上的工作量

IACS 决议和建议案的要求可能对船上和岸上的工作量产生影响。

应考虑下列与船上工作有关的方面，特别是在航程和港口作业的密集阶段。

- 操作，包括航行、货物和工程
- 船舶结构及其设备的维护
- 支持船舶管理系统的船上管理工作
- 涉及船旗国、船级社、港口国和其他机构（诸如船舶租赁和港口当局）相关法规的船上管理工作
- 在实施日期前如果涉及到落实任何变更给人员带来的额外工作量或时间压力

应考虑下列与岸上工作相关且会影响船舶运营的方面：

- 公司管理

- 船旗国、港口国和船级社的管理导致发证和其他流程受到影响或延迟

5.2.2 决策

输出文件的要求可能对船上和岸上决策过程产生影响。

应基于理解输出文件的要求是否通过下列方式对船上决策产生影响，对人为因素考虑因素进行识别：

- 与现有要求和规则的混淆
- 改变安全管理系统中的职责
- 在执行过程和/或在安全管理系统中产生复杂性
- 需要增加脑力投入，例如需要查找、转换和分析数据，或导致需要基于不完整信息做出判断
- 限制用于建立情境感知、做出决策、（可能跨时区）进行沟通或检查的时间
- 增加对判断和管理控制的依赖来管理重大风险，诸如溢油和碰撞。

5.2.3 生活和工作环境

输出文件的要求可能会对生活和工作环境产生影响。

应基于理解输出文件的要求是否正通过下列方式影响生活和工作环境，对人为因素考虑因素进行识别：

- 与现有的关于弃船、防火和其他应急计划或程序相干扰
- 引入可能造成爆炸、火灾、环境或职业健康风险的新材料
- 引入新的高能能源，诸如高电压、高压流体
- 影响进出通道导致工作处所通风不良
- 由于噪音、振动、温度、灰尘和其他污染物影响居住处所的可居住性

5.2.4 操作和维护

输出文件的要求可能会对船舶的操作和维护、其结构或系统和设备产生影响

应基于理解输出文件的要求是否正通过下列方式影响船舶的操作和维护、其结构或系统和设备，对人为因素考虑因素进行识别：

- 引入的设备使用户觉得难以操作或维护或可能不可靠
- 引入新的和/或新技术，或改变人员角色的技术
- 引入对新技能和新岗位的要求
- 发电装置和通风系统等现有基础设施过载
- 与现有系统和控制融合度差
- 引入新的和不熟悉的操作/程序
- 引入新的和不熟悉的操作界面
- 在决议或建议案执行日期之前所要求的改装期间对船舶引入了风险

5.3 处理人为因素的措施

在人为因素考虑因素识别阶段结束时，用户应能够识别哪些方面需要采取措施处理人为因素影响。

以下可能需要采取措施处理人为因素影响的方面，应予以考虑：

- 人员培训
- 实操技能的培养和能力建设
- 操作、管理和/或维护程序
- 操作和维护信息/手册
- 备件配备
- 职业安全要求，包括防护装置和个人防护装备（PPE）
- 岸上支持

5.4 风险控制措施的识别

5.4.1 引言

IMO 已将风险控制层级纳入 IMO 输出文件（MSC-MEPC.1/Circ.5/Rev.4 通函附件 5）的人为因素处理流程，强调海事行业传统的做法是通过培训、程序和个人防护装备来应对人员遭受和引发的伤害，而非优先采取避免或减小风险的解决方案。总的来说，控制层级也支持遵循安全原则的设计过程。这与“安全 2 概念”的目标高度契合。

用户应利用控制层级理念，基于在设计阶段预判并消除风险的原则，重点聚焦于可能实施的高级风险控制措施（源头消除措施）。如此可制定出具有设计安全和防故障特性的要求，从而减少船舶和航运公司对额外知识储备、培训和引入新的或修改流程和程序的需求。

5.4.2 控制层级

考虑风险时，应认识到可能有替代方式来处理风险。这些方式在有效性方面有所不同，下列风险控制层级对此有所描述（最先由美国国家职业安全与健康研究所提出(参考 MSC-MEPC.1/Circ.5/Rev.4 通函附件 5)）。

- 消除-物理消除风险是最有效的控制方式。航运业相关人为因素示例：通过将设备的所有关键部件放在甲板上，可以消除为该维护设备而进行高空工作的要求。
- 替代-以不会产生危险的事物替代产生危险的事物。航运业相关示例：采用不含三丁基锡的防污漆替代含三丁基锡防污漆。
- 工程控制-这类方式不会消除风险，而是将人与风险隔离。航运业相关人为因素示例：将自带高噪声级别的设备隔离在隔音罩中，或为设备的旋转部件加装保护装置，防止操作人员与其接触。
- 管理控制-改变人员的工作方式。例如报警、警示标识、操作规程或培训，一般被视为效用相对较低的控制方式。
- 个人防护装备（PPE）-这种控制方式为视为效用最低的方式，因为难以确保 PPE 的适当使用和维护。此外，部分个人防护装备还会增加人员完成作业任务的生理负荷。

“消除”和“替代”风险控制措施被定义为从源头消除（固有安全）措施，应作为任何输出文件在设计中的核心点。在降低风险的工作中，“消除”和“替代”被定义为高级的和最为推荐的两种风险控制措施。

“工程控制”风险控制措施被定义为中等级别，是在减少人为因素风险中次优选择的措施。这种措施的目标是消除或替代作业与流程执行过程中人为操作，从而减少人员暴露在危险中。这一目标可以通过诸如自动化流程、改用危害较小的材料和/或重新设计流程以减少或省去人为操作来实现。如上述不能实现，则可通过防护和/或保安装置来减少人员暴露在危险中的可能性。这可以通过例如引入挡板、联锁装置、双手控制装置和脱扣装置或类似装置实现。

“管理控制”和“PPE”风险控制措施被定义为低级控制措施，在减少人为因素风险方面作为第三选择的措施。

管理控制包括三种类型风险控制措施：

- 感知设备（灯光警告、声音警告、标识和标签）
- 人员培训和程序（安全作业程序和实践、安全设备检查、安全培训）
- 个人防护装备（安全镜、工装裤、保护鞋套、呼吸器等）

在识别合适的风险控制措施时，用户应本着在设计阶段预判和消除风险的原则，主要关注可能实施的高级风险控制措施。

在任何输出文件中识别和执行高级风险控制措施，应能促成具有设计安全和防故障特性的要求，同时减少船舶和航运公司对额外知识储备、培训和引入新的或修改流程和程序的需求。

如果输出文件为技术性文件，风险控制措施应集中于消除、替代（高级控制措施），最后考虑工程控制。

对于高级风险控制措施，一旦确定，应纳入输出文件，这将确保技术性输出文件的要求建立在以人为中心的设计上，并减少和/或消除对相关要求执行人员的影响。

如果高级风险控制措施无法执行或不够有效，应采取中级或低级风险控制措施。

中级和低级风险控制措施的执行，可能需要船舶和航运公司具备的额外知识储备、培训和引入新的或修改流程和程序。

与管理控制措施和 PPE（低级风险控制措施）实施相关的信息不应予以定义，但应记录在表 1 相关部分。公司的职责是为岸上和船上人员提供具体和充分的组织、程序和培训，以确保符合输出文件。

确定的风险控制措施应考虑到预期的输出及其对人为因素的直接影响，以及任何潜在的非预期后果。同时，该类措施还应考虑实施日期之前的情况（可能需要进行修改）和实施完成之后的情况。

理解考虑因素的影响和风险控制措施的说明可能需要人为因素/人机工程学的专业知识。

用户应保留在制定输出文件时开展的人为因素影响评估总结，以与其他用户交流经验。该总结应包括关于已识别的对人为因素的影响，和已执行的高级风险控制措施和确定的低级风险控制措施方面的信息。

表 1 提供了人为因素问题评估待解决的部分问题清单，并应由用户在制定输出文件时完成。清单包括 5 个问题：问题 1 至 4 是基于风险的问题，用于识别与执行和操作输出文件相关的风险，问题 5 是处理人为因素的措施清单。

表 1 中定义的问题和人为因素影响评估方法是基于 IMO MSC-MEPC.1/Circ.5/Rev.4 通函附件 5 关于“国际海事组织各机构人为因素考量的监督与控制”，其在制定输出文件时同样适用。

1. 工作量		
人为因素的考虑因素		
1.1 输出文件中影响船上工作量的要求是关于：		
1.1.1 包括航行、货物和工程在内的操作。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
1.1.2 船舶结构及其设备的维护。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
1.1.3 支持船舶管理系统的船上管理工作。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
1.1.4 涉及船旗国、船级社、港口国及其他机构（如承租人和港口当局）相关法规的船上管理工作	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
1.1.5 在实施日期前如果涉及到落实任何变更给人员带来的额外工作量或时间压力	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
危险控制措施的识别		
考虑因素	措施类型	控制措施的说明
1.1.1 包括航行、货物和工程在内的操作。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
1.1.2 船舶结构及其设备的维护。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
1.1.3 支持船舶管理系统的船上管理工作。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
1.1.4 涉及船旗国、船级社、港口国及其他机构（如承租人和港口当局）相关法规的船上管理工作	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
1.1.5 在实施日期前如果涉及到落实任何变更给人员带来的额外工作量或时间压力	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。

人为因素的考虑因素		
1.2 输出文件中影响岸基工作量的要求是关于：		
1.2.1 公司管理	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
1.2.2 船旗国、港口国和船级社的管理导致发证和其他流程受到影响或延迟	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
危险控制措施的识别		
考虑因素	措施类型	控制措施的说明
1.2.1 公司管理	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
1.2.2 船旗国、港口国和船级社的管理导致发证和其他流程受到影响或延迟	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。

2. 决策		
人为因素的考虑因素		
2.1 输出文件的要求通过以下方式影响决策过程：		
2.1.1 与现有要求和规定相混淆。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
2.1.2 改变了安全管理系统中规定的职责。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
2.1.3 给其执行和/或安全管理系统增加了复杂度。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
2.1.4 需要增加脑力投入，例如需要查找、转换和分析数据，或导致需要基于不完整信息做出判断	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
2.1.5 限制用于建立情境感知、做出决策、（可能跨时区）进行沟通或检查的时间。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
2.1.6 增加对判断和管理控制的依赖来管理重大风险，诸如溢油和碰撞。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。	
危险控制措施的识别		
考虑因素	措施类型	控制措施的说明
2.1.1 与现有要求和规定相混淆。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
2.1.2 改变了安全管理系统中	高/中/低	请说明所采用的“高级”和“中级”危险控制措

规定的职责。		施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
2.1.3 给其执行和/或安全管理系统增加了复杂度。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
2.1.4 需要增加脑力投入，例如需要查找、转换和分析数据，或导致需要基于不完整信息做出判断	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
2.1.5 限制用于建立情境感知、做出决策、（可能跨时区）进行沟通或检查的时间。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
2.1.6 增加对判断和管理控制的依赖来管理重大风险，诸如溢油和碰撞。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑的“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。

3. 生活和工作环境		
人为因素的考虑因素		
3.1 输出文件的要求通过以下方式影响船上生活和工作环境：		
3.1.1 干扰现有的弃船、消防和其他应急计划或程序的安排。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
3.1.2 引入可能造成爆炸、火灾、环境或职业健康危害的新材料。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
i 引入新的高能能源，如高压电、高压流体。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
ii 影响进出通道导致工作处所通风不良。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
iii 由于噪声、振动、温度、灰尘或其他污染物而影响起居处所的可居住性。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
危险控制措施的识别		
考虑因素	措施类型	控制措施的说明
3.1.1 干扰现有的弃船、消防和其他应急计划或程序的安排。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人

		员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
3.1.2 引入可能造成爆炸、火灾、环境或职业健康危害的新材料。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
3.1.3 引入新的高能能源，如高压电、高压流体。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
3.1.4 影响进出通道导致工作处所通风不良。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
3.1.5 由于噪声、振动、温度、灰尘或其他污染物而影响起居处所的可居住性。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。

4. 操作和维护	
人为因素的考虑因素	
4.1 输出文件的要求通过以下方式影响船舶结构或系统和设备的运营和维护：	
4.1.1 引入用户可能难以操作或维护或可能不可靠的设备。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
4.1.2 引入新兴和/或新奇技术，或者引入的技术改变了人的角色。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
4.1.3 引入对新技能和新岗位的要求。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
4.1.4 使现有的基础设施（如发电和通风系统）超载。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
4.1.5 与现有的系统和控制融合不佳。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
4.1.6 引入新型且不熟悉的操作/程序。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
4.1.7 引入新型且不熟悉的操作界面。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
4.1.8 在决议或建议案实施日期前进行任何所需的改装给船舶带来的风险。	请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
危险控制措施的识别	

考虑因素	措施类型	控制措施的说明
4.1.1 引入用户可能难以操作或维护或可能不可靠的设备。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
4.1.2 引入新兴和/或新颖技术，或者引入的技术改变了人的角色。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
4.1.3 引入对新技能和新岗位的要求。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
4.1.4 使现有的基础设施（如发电和通风系统）超载。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
4.1.5 与现有的系统和控制融合不佳。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
4.1.6 引入新型且不熟悉的操作/程序。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
4.1.7 引入新型且不熟悉的操作界面。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
4.1.8 在决议或建议案实施日期前进行任何所需的改装给船舶带来的风险。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。

5. 解决人为因素的措施

人为因素的考虑因素

5.1 输出文件的要求是否从以下方面考虑危险控制措施：		
5.1.1 人员培训。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
5.1.2 实践技能和能力的培养。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
5.1.3 操作、管理和/或维护的程序。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
5.1.4 操作和维护的资料/手册。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
5.1.5 备件装备。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
5.1.6 包括防护装置和个人防护装备在内的职业安全要求。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
5.1.7 岸基支持。		请描述已识别的人为因素考虑因素；若未识别出人为因素考虑因素，请提供相应理由。
危险控制措施的识别		
考虑因素	措施类型	控制措施的说明
5.1.1 人员培训。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
5.1.2 实践技能和能力的培养。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
5.1.3 操作、管理和/或维护的程序。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
5.1.4 运营和维护的资料/手册。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
5.1.5 备件装备。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
5.1.6 包括防护装置和个人防护装备在内的职业健康要	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施

求。		施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。
5.1.7 岸基支持。	高/中/低	请说明所采用的“高级”和“中级”危险控制措施；若未采用“高级”和“中级”危险控制措施，请提供相应理由。请识别船上及公司人员应考虑“低级”危险控制措施。危险控制措施应属于前一栏中确定的类别。

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Guidelines to Address Human Element Issues

(Sep 2025)

1. Purpose

1.1 The purpose of these guidelines is to provide information on how IACS Working Groups are considering the complex, multi-dimensional issue of the human element in development of resolutions and recommendations. These guidelines may also be useful for other organisations, hereinafter referred as users, in shipping industry when developing similar documents (codes, conventions, standards) hereinafter referred as output. Use of Table 1 at the end of these guidelines will ensure that the users consistently consider and identify any human element impact of the output. Table 1 can be used iteratively during the development of the output to mitigate and/or control any identified impacts.

2. Background

2.1 The consideration of the human element issues in the shipping industry has long been considered as an important aspect by IMO. In accordance with Principles defined by IMO in Resolution A.947(23) on Human Element vision, principles and goals for the Organization the human element is a complex multi-dimensional issue that affects maritime safety, security and marine environmental protection. It involves the entire spectrum of human activities performed by ships crews, shore-based management, regulatory bodies, recognized organizations, shipyards, legislators, and other relevant parties, all of whom need to cooperate to address human element issues effectively.

2.2 Safety, including inherently safe design, depends on understanding what is expected of people and whether they can meet these expectations, whether in interpreting an output working with an arrangement, equipment or procedure designed to meet requirements of the outputs, and reacting to (or being in the vicinity of) a failure or reasonably foreseeable event that should be mitigated by the requirements of the outputs.

2.3 Consideration of hazards should recognize that there may be alternative means, different in their effectiveness, by which these may be addressed. Users should seek to create outputs that require the elimination or reduction of hazards in the design stage.

2.4. A human-centred approach, considering how to take best advantage of human abilities and to compensate for human weaknesses as well as to foresee risks posed by persons, should be used as a starting point of any output that holistically considers the impact on and from the human element.

2.5. Analysis of human element issues is a holistic process. It should include multiple aspects such as human performance and motivation, health and safety, allocation of functions, job and workplace design, knowledge from previous experience, introduction of new and unfamiliar technologies into ship systems with final aims to make a design safe and develop fail proof requirements.

3. The human-centred approach

3.1 One of the primary objectives of this guideline is introduction and promotion of human-centred approach as a key element in human element issues impact analysis in development of outputs in the shipping industry.

3.2 The human-centred approach holds that one of the primary features that a person brings to the system is a sense of purpose and action. When the purpose (the goal) is understood it is possible to begin to design a system to facilitate it.

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3.3 The human-centred approach takes as its central point the need to accommodate the human attributes which the person brings to the system. The emphasis is on accentuating the positive and reducing the negative effects of a person's interactions.

3.4 The human-centred approach represents a major shift in the way in which designers view the role of the person within the working situation. It takes advantage of human flexibility, supports people's ability to learn and compensates for their biological (and other) 'weaknesses'.

3.5 The task is to design a supportive enough environment to facilitate such compensating behaviour, i.e. design from the human out.

3.6 Human Factors in the design of safe, secure and sustainable systems thus requires consideration of many factors. The approach by which this is achieved is defined by ISO as Human-Centred Design.

3.7 The practice of taking account of ergonomics guidelines and information about human capabilities and limitations is often called "human factors engineering".

4. Activity impact on human element

4.1 It is important that the effect **of** people as much as the effect **on** people who will operate, apply, assure, maintain, or be affected by any output, as well as the effect in terms of overall safety, security and environmental impact of any new output is identified at an early stage.

4.2 A common misconception is that the ISM Code is IMO's solution to the Human Element. However, the scope of IMO instruments extends beyond the ISM Code. The Health and Safety approach to human factors/ergonomics is close to the ISM Code, but human factors/ergonomics was invented to maximise human performance and works well with the following aspects of the "Safety 2" concept:

- 1) Identify the main hazards that the output is to address
- 2) Use the Hierarchy of Controls to identify possible measures to remove or reduce identified hazards.
- 3) Make the treatment of the hazards better and more precise with respect to human element issues by using the checklist.

4.3 This approach works in parallel with and takes account of the human-centred approach that clarifies the purpose of the people with respect to the operation and safety of the system and what support that they need in performing the operation in safe way and could be summarized as "job, hazards, people, working environment".

5. Assessment of human element issues

5.1 Introduction

Assessment of human element issues arising from the development and subsequent implementation of output should be performed by users developing the output.

Activity impact on human element is the process which should consider two aspects:

Effect ON the people by the system due to

- new or modified individual tasks and organizational requirements
- new or modified operations
- new or modified technologies

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- new or modified maintenance requirements
- new or modified knowledge and training requirements

Effect OF the people to the system due to

- excessive workload, fatigue and stress
- inadequate communication and organization
- inadequate knowledge and training

Proper assessment, in the early stage of the output development, of the impact on the human element issues, by use of human-centred approach, would enable users to identify possible impact for the entire spectrum of human activities performed by ships crews, shore-based management, regulatory bodies, recognized organizations, shipyards, legislators, and other relevant parties, all of whom need to cooperate to address human element issues effectively.

Assessment of human element issues is a creative activity and should consider following two steps:

- identification of human element considerations
- identification of hazard control measures

Assessment of human element issues should relate to the complete scope and purpose of the output.

This includes:

- the work being done,
- number, location and roles of people involved,
- ship (or other physical) arrangements,
- operational procedures and duration of event or activity (this may be continuous, intermittent or in abnormal circumstances).

Two techniques are recommended to assist creative thinking about human element issues, “*Context of Use Analysis*” and “*Critical Examination*”.

“*Context of Use Analysis*” reviews what is going on around the use of a procedure, arrangement, or equipment under the following headings:

- USERS - User types, Secondary or indirect users, Skills and knowledge, Relevant qualifications, Relevant skills, Physical attributes, Motivations (positive or negative), Job characteristics
- TASK CHARACTERISTICS – Goal, Activities, Choice, Task output, Side effects or risks of performing the task, Task frequency, Task duration & Task flexibility, Physical and mental demands, Task dependencies, Linked tasks, Safety or environmental issues, How critical is the output of the task
- RESOURCES – Reusable resources, Expendable resources
- ENVIRONMENT - Technical Environment, Physical Environment, Social, Cultural and Organisational Environment

“*Critical Examination*” is the name for the classic six questions:

- What is to be done?
- Where is it being done?
- Who is doing it?
- What order are the activities?

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- Why that way?
- How else could it be done?

Outputs in shipping industry include design, engineering, materials, structures and nowadays controls with different Human Element considerations for each. These are typically as follows:

- For Hull Structures the users of the output will be within the Class structure and design offices. How is the reader expected to use content, how readable, how will it be interpreted, organisational fit of procedure.
- For Machinery and Equipment, the question will be what does “safe” mean for the system, understanding what will happen to people and what they need to do.
- For Materials the main consideration will be managing the effect of material properties at all stages in the lifecycle, quality control/ management competence/ inspection/ analysis.
- For Procedures both our procedures and those that we require, the consideration will be where are they be applied and by who.
- Instruments/outputs will address new and complex technologies which have new ergonomics issues. Most of these new technologies rely heavily on, or are implemented in, ICT (information and computer technology). The usability/user experience of these systems will be a critical part of their safe operation and will be different for each subject area.

5.2 Identification of human element considerations

IMO has selected the most important sets of consideration for the safety of modern shipping and reduced the list to 33 considerations grouped under these five headings (Ref, MSC-MEPC.1/Circ.5/Rev.4, Annex 5). IMO advises that human element considerations should be identified in the following areas as a first step in the development of any new resolutions and recommendations:

1. Workload onboard and ashore
2. Decision making
3. Living and working environment
4. Operation and maintenance
5. Measures to address the Human Element

A checklist for recording considerations and resulting actions is provided in Table 1. The procedure to follow in applying the checklist is shown in Figure 1.

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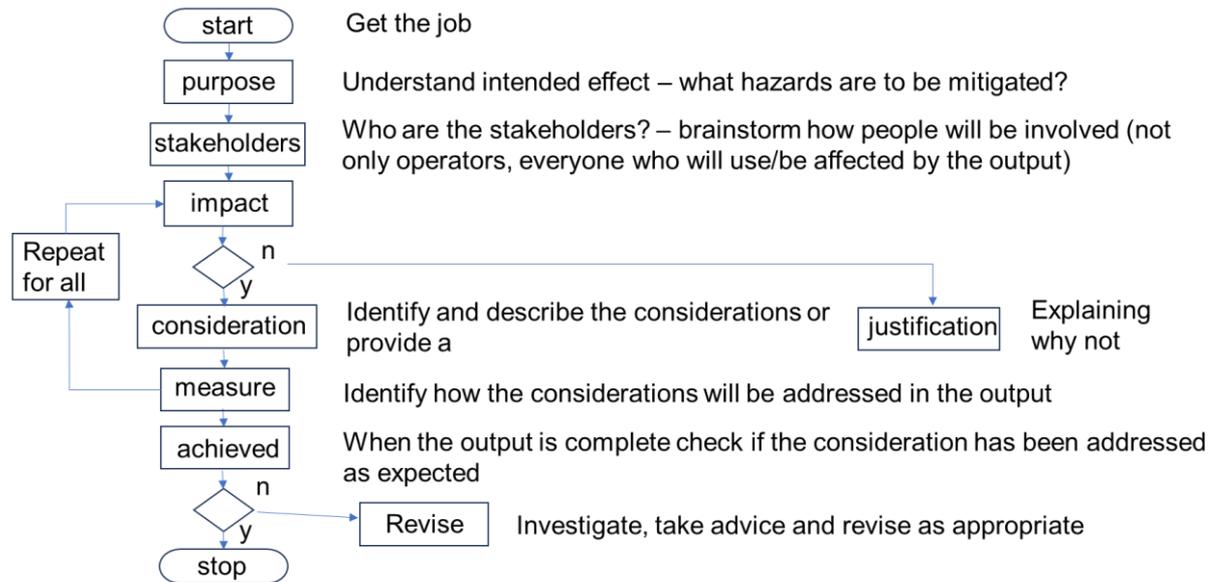


Figure 1 Procedure for considering the human element in the development of resolutions and recommendations

The following subsections elaborate the human element considerations.

5.2.1 Workload onboard and ashore

Requirements of outputs may have an impact on workload both onboard and ashore.

Following aspects related to work on board, especially in the already intensive phases of the voyage and port operations shall be considered

- Operations including navigation, cargo and engineering
- Maintenance of the ships structure and its equipment
- Onboard administration in support of the ships management systems
- Onboard administration related to regulation involving flag States, classification societies, port State and other bodies such as charterers and port authorities
- Increased workload or time pressure on personnel if involved in implementation of changes prior to the implementation date

Following aspects related to work ashore, in a manner that would affect the ships operation shall be considered:

- Companies administration
- Flag State, port State and classification societies administration such that certification and other processes are compromised or delayed

5.2.2 Decision making

Requirements of the outputs may have an impact on decision making processes both onboard and ashore.

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Identification of human element considerations shall be based on understanding if requirements of the outputs impact decision-making on board the ship by:

- Confusion with existing requirements and regulations
- Changing responsibilities as laid out in the Safety Management System
- Creating complexity in its implementation and/or in the Safety Management System
- Requiring increased mental effort, such as the need to find, transform and analyse data or result in the need to make judgements based on incomplete information
- By limiting the time available to establish situational awareness, decide, communicate (possibly across time zones) or check
- Increasing reliance on judgement and administrative controls to manage major risks such as oil spills and collisions

5.2.3 Living and working environment

Requirements of the outputs may have an impact on living and working environment.

Identification of human element considerations shall be based on understanding if requirements of the output are affecting the living and working environment onboard by:

- Interfering with existing arrangements for abandonment, fire-fighting and other emergency plans or procedures
- Introducing new materials that could create an explosion, fire, environmental or occupational health risk
- Introducing new high energy sources such as high-voltage, high pressure fluids
- Affecting access or egress and causing lack of ventilation in working spaces
- Affecting the habitability of accommodation spaces due to noise, vibration, temperatures, dust and other contaminants

5.2.4 Operation and maintenance

Requirements of the outputs may have an impact on the operation and maintenance of the ship, its structure or systems and equipment by

Identification of human element considerations shall be based on understanding if requirements of the output are affecting the operation and maintenance of the ship, its structure or systems and equipment by:

- Introducing equipment that the user may find difficult to operate or maintain or may be unreliable
- Introducing new and/or novel technology, or technology that changes the role of the person(s)
- Introducing requirements for new competencies and roles
- Overloading existing infrastructure such as power generation and ventilation systems
- Poor integration with existing systems and controls
- Introducing new and unfamiliar operations/procedures
- Introducing new and unfamiliar operating interfaces?
- Introducing risks to the ship during any modifications required prior to the implementation date of the resolution or recommendation

5.3 Measures to address the Human Element

At the end of identification of human element considerations stage the users should be able to identify aspects where measures to address impact on Human Element are required.

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Following aspects where measures to address impact to Human Elements may be required shall be considered:

- Training of personnel
- Practical skill development and competences
- Operating, management and/or maintenance procedures
- Information/manuals for operation and maintenance
- Spares outfit
- Occupational safety requirements including guarding and PPE
- Shore support

5.4 Identification of hazard control measures**5.4.1 introduction**

IMO included the Hierarchy of Hazard Controls in its procedure for addressing the Human Element in IMO outputs (MSC-MEPC.1/Circ.5/Rev.4 Annex 5) to highlight the maritime habit of addressing harm to and from people with training, procedures and PPE rather than encouraging solutions that avoided or minimised the hazard in the first place. As a whole the Hierarchy of Controls also supports a design process that has a principle of safety. This aligns closely with the purpose of “Safety 2 Concept”.

Users should apply the Hierarchy of Controls philosophy and primarily be focused on possible implementation of high-level hazard control measures (design out measures) based on foreseeing and elimination of hazards in the design stage. That would result in designing safe and fail proof requirements to reduce the need for additional knowledge, training and introduction of new or modified processes and procedures onboard and in shipping companies.

5.4.2 Hierarchy of controls

Consideration of hazards should recognize that there may be alternative means by which risks may be addressed. These means differ in their effectiveness as illustrated by the following Hierarchy of Hazard Controls (originated by the National Institute for Occupational Safety and Health, United States of America (Ref. MSC-MEPC.1/Circ.5/Rev.4 Annex 5))

- Elimination – Physically removing the hazard is the most effective control. A Human Factors example from the shipping industry might be that a requirement for working at height to maintain a piece of equipment could be eliminated by having all critical components at deck level.
- Substitution – Involves replacing something that produces a hazard with something that does not produce a hazard. An example in the shipping industry might be the substitution of non-TBT anti-fouling.
- Engineering controls – These do not remove hazards, but rather isolate people from hazards. Human Factors examples in the shipping industry might be equipment with inherently high noise levels isolated by locating in an acoustic enclosure or the rotating part of equipment fitted with a guard to prevent contact with the operator.
- Administrative controls – These are changes in the way people work. Examples may be alarms, signage, procedures or training and are generally seen as less effective controls.

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- Personal protective equipment (PPE) – This control is seen as the least effective due to the problems with ensuring that PPE is properly used and maintained. In addition, some PPE increases physiological effort to complete a task.

“Elimination” and “substitution” hazard control measures are defined as design-out (inherently safe) measures and should be used as a central point in the design of any output. Elimination and substitution hazard control measures are also defined as high level and the most preferred in relation to reduction of risks.

“Engineering controls” hazard control measures are defined as medium level and second preferred in relation to reduction of human element risks. The aim of such measures is to eliminate or substitute human actions in performance of operations and processes to reduce the exposure of persons to the hazards under consideration. This can be achieved, for example, by automated processes, substituting less hazardous materials and/or (re)designing processes to reduce or eliminate human action. If this is not possible then identify guards and/or safeguard devices which reduce the probability of person exposure to hazards under consideration. This can be achieved, for example, by the introduction of barriers, interlocks, two hand control and trip devices or similar.

“Administrative controls” and “PPE” hazard control measures are defined as low level and third preferred in relation to reduction of human element risks.

Administrative controls include three types of hazard control measures:

- awareness devices (light warnings, sound warnings, signs and labels)
- training and procedures to people (safe working procedures and practices, safety equipment inspections, safety training)
- personal protective equipment (safety glasses, overalls, protective footwear, respirators etc.)

In the identification of appropriate hazard control measures the users should primarily be focused on possible implementation of high-level hazard control measures based on foreseeing and elimination of hazards in a design stage.

Identification and implementation of high-level hazard control measures in any output should result in design safe and fail proof requirements and reduce the need for additional knowledge, training and introduction of new or modified processes and procedures onboard and in shipping companies.

In case of outputs of technical nature, hazard control measures shall be focused on elimination, substitution (high level control measures) and lastly engineering hazard controls.

High level hazard control measures, once identified, shall be incorporated in output. That would ensure that the outputs of technical nature are built up on human-centred design and reduce and/or eliminate impacts to persons required to implement the requirements.

Where implementation of high-level hazard control measures is not possible or not sufficiently effective, medium or low-level hazard control measures should be identified.

Implementation of medium and low-level hazard control measures may require additional knowledge, training and introduction of new or modified processes and procedures onboard and in shipping Companies.

Detailed information related to implementation of identified administrative control measures and PPE (low level hazard control measures) should not be defined but should be recorded in

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relevant parts of Table 1. It is the task of companies to identify and provide specific and adequate organization, procedures and training to personnel both onshore and onboard in order to ensure compliance with outputs.

Identified hazard control measures should take account of both the intended output and its direct effects on the human element, as well as any potential unintended consequences. It should also take into account the effects of both the circumstances prior to the implementation date, where modifications may be made, and once implementation is complete.

Understanding the impact of a consideration and specification of a hazard control measure may require Human Factors/Ergonomics expertise.

Users should maintain a summary of Human Element impact assessments performed during development of outputs in order to exchange experience with other users. This summary should include information about identified impacts to Human Element as well as implemented high level hazard control measures and identified low level hazard control measures.

Table 1 provides a list of questions to be addressed as part of the human element issues assessment and should be completed by users in development of outputs. The checklist consists of five questions. Questions 1 to 4 are risk-based questions intended to identify risks associated with the implementation and operation of outputs. Question 5 is a list of measures for addressing the Human Element.

Questions and Human Element impact assessment methodology defined in Table 1 is based on IMO MSC-MEPC.1/Circ.5/Rev.4, Annex 5 related to ***Monitoring and Controlling Consideration of the Human Element by IMO Bodies*** and is equally applicable in development of outputs.

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1. WORKLOAD		
Human Element Considerations		
1.1 Are the requirements of the output affecting workload onboard related to:		
1.1.1	Operations including navigation, cargo and engineering	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
1.1.2	Maintenance of the ships structure and its equipment	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
1.2.3	Onboard administration in support of the ships management systems	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
1.2.4	Onboard administration related to regulation involving flag States, classification societies, port State and other bodies such as charterers and port authorities	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
1.2.5	Increased workload or time pressure on personnel if involved in implementation of changes prior to the implementation date	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
Hazard Control Measures Identification		
Consideration	TYPE OF MEASURES	Specification of control measures
1.1.1	Operations including navigation, cargo and engineering	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
1.1.2	Maintenance of the ships structure and its equipment	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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1.1.3 Onboard administration in support of the ships management systems	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
1.1.4 Onboard administration related to regulation involving flag States, classification societies, port State and other bodies such as charterers and port authorities	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
1.1.5 Increased workload or time pressure on personnel if involved in implementation of changes prior to the implementation date	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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Human Element Considerations		
1.2 Are the requirements of the output affecting workload ashore related to:		
1.2.1 Companies administration		<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
1.2.2 Flag State, port State and classification societies administration such that certification and other processes are compromised or delayed		<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
Hazard Control Measures Identification		
Consideration	Type of Measures	Specification of control measures
1.2.1 Companies administration	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
1.2.2 Flag State, port State and classification societies administration such that certification and other processes are compromised or delayed	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

2. DECISION MAKING		
Human Element Considerations		
2.1 Are the requirements of the output affecting decision making processes by:		
2.1.1	Confusion with existing requirements and regulations	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
2.1.2	Changing responsibilities as laid out in the Safety Management System	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
2.1.3	Creating complexity in its implementation and/or in the Safety Management System	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
2.1.4	Requiring increased mental effort, such as the need to find, transform and analyse data or result in the need to make judgements based on incomplete information	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
2.1.5	Limiting the time available to establish situational awareness, decide, communicate (possibly across time zones) or check	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
2.1.6	Increasing reliance on judgement and administrative controls to manage major risks such as oil spills and collisions	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
Hazard Control Measures Identification		
Consideration	TYPE OF MEASURES	Specification of control measures
2.1.1	Confusion with existing requirements and regulations	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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2.1.2 Changing responsibilities as laid out in the Safety Management System	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
2.1.3 Creating complexity in its implementation and/or in the Safety Management System	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
2.1.4 Requiring increased mental effort, such as the need to find, transform and analyse data or result in the need to make judgements based on incomplete information	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
2.1.5 Limiting the time available to establish situational awareness, decide, communicate (possibly across time zones) or check	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
2.1.6 Increasing reliance on judgement and administrative controls to manage major risks such as oil spills and collisions	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

3. LIVING AND WORKING ENVIRONMENT		
Human Element Considerations		
3.1 Are the requirements of the output affecting the living and working environment onboard by:		
3.1.1	Interfering with existing arrangements for abandonment, fire-fighting and other emergency plans or procedures	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
3.1.2	Introducing new materials that could create an explosion, fire, environmental or occupational health risk	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
i.	Introducing new high energy sources such as high-voltage, high pressure fluids	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
ii.	Affecting access or egress and causing lack of ventilation in working Spaces	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
iii.	Affecting the habitability of accommodation spaces due to noise, vibration, temperatures, dust and other contaminants	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
Hazard Control Measures Identification		
Consideration	TYPE OF MEASURES	Specification of control measures
3.1.1	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
3.1.2	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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3.1.3 Introducing new high energy sources such as high-voltage, high pressure fluids	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
3.1.4 Affecting access or egress and causing lack of ventilation in working spaces	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
3.1.5 Affecting the habitability of accommodation spaces due to noise, vibration, temperatures, dust and other contaminants	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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4. OPERATION AND MAINTENANCE		
Human Element Considerations		
4.1 Are the requirements of the output affecting the operation and maintenance of the ship, its structure or systems and equipment by:		
4.1.1	Introducing equipment that the user may find difficult to operate or maintain or may be unreliable	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
4.1.2	Introducing new and/or novel technology, or technology that changes the role of the person(s)	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
4.1.3	Introducing requirements for new competencies and roles	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
4.1.4	Overloading existing infrastructure such as power generation and ventilation systems	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
4.1.5	Poor integration with existing systems and controls	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
4.1.6	Introducing new and unfamiliar operations/procedures	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
4.1.7	Introducing new and unfamiliar operating interfaces?	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
4.1.8	Introducing risks to the ship during any modifications required prior to the implementation date of the resolution or recommendation	<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
Hazard Control Measures Identification		
Consideration	TYPE OF MEASURES	Specification of control measures
4.1.1	Introducing equipment that the user may find difficult to operate or maintain or may be unreliable	HIGH/MEDIUM/LOW <i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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4.1.2 Introducing new and/or novel technology, or technology that changes the role of the person(s)	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
4.1.3 Introducing requirements for new competencies and roles	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
4.1.4 Overloading existing infrastructure such as power generation and ventilation systems	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
4.1.5 Poor integration with existing systems and controls	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
4.1.6 Introducing new and unfamiliar operations/procedures	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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4.1.7 Introducing new and unfamiliar operating interfaces?	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
4.1.8 Introducing risks to the ship during any modifications required prior to the implementation date of the resolution or recommendation	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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5. MEASURES TO ADDRESS THE HUMAN ELEMENT		
Human Element Considerations		
5.1 Do the requirements of the the output consider Hazard Control Measures in following aspects:		
5.1.1 Training of personnel		<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
5.1.2 Practical skill development and competences		<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
5.1.3 Operating, management and/or maintenance procedures		<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
5.1.4 Information/manuals for operation and maintenance		<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
5.1.5 Spares outfit		<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
5.1.6 Occupational safety requirements including guarding and PPE		<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
5.1.7 Shore support		<i>Describe identified HE considerations or provide justification in case no HE considerations were identified</i>
Hazard Control Measures Identification		
Consideration	TYPE OF MEASURES	Specification of control measures
5.1.1 Training of personnel	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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5.1.2 Practical skill development and competences	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
5.1.3 Operating, management and/or maintenance procedures	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
5.1.4 Information/manuals for operation and maintenance	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
5.1.5 Spares outfit	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
5.1.6 Occupational safety requirements including guarding and PPE	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>

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5.1.7 Shore support	HIGH/MEDIUM/LOW	<i>Specify applied HIGH AND MEDIUM LEVEL Hazard Control Measures or provide justification in case no Hazard Control Measures were applied. Identify LOW LEVEL Hazard Control measures to be considered by ship and company personnel. Hazard Control Measures shall be from the categories identified in previous column.</i>
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