

ABSTRAK

Aktivitas pembersihan *flour silo* merupakan pekerjaan pada ruang terbatas yang memiliki berbagai potensi bahaya sehingga memerlukan pengendalian risiko yang efektif untuk mencegah terjadinya kecelakaan kerja. Gangguan komunikasi antara operator di dalam silo dan petugas pengawas di luar silo menjadi salah satu risiko yang masih memiliki tingkat risiko tinggi setelah penerapan pengendalian yang telah ada. Penelitian ini bertujuan untuk menilai tingkat risiko pada aktivitas pembersihan *flour silo* menggunakan metode *Hazard Identification, Risk Assessment and Determining Control* (HIRADC) berbasis risk matrix serta menyusun rekomendasi pengendalian risiko melalui pendekatan engineering control. Penelitian menggunakan metode deskriptif dengan pendekatan kualitatif. Pengumpulan data dilakukan melalui observasi lapangan, wawancara, dokumentasi, dan kegiatan diskusi bersama pihak perusahaan. Identifikasi bahaya dilakukan pada seluruh tahapan aktivitas pembersihan *flour silo*, kemudian dilakukan penilaian risiko berdasarkan parameter *likelihood* dan *severity* menggunakan risk matrix. Rekomendasi pengendalian disusun berdasarkan hirarki pengendalian, kemudian dikembangkan usulan engineering control berupa desain konseptual *Smart Confined Space Communication Earbud* menggunakan Autodesk Fusion 360. Hasil identifikasi menunjukkan bahwa aktivitas pembersihan *flour silo* memiliki berbagai potensi bahaya dengan tingkat risiko yang bervariasi, mulai dari kategori *low*, *medium*, *high*, hingga *extreme*. Pengendalian yang telah diterapkan mampu menurunkan sebagian besar tingkat risiko, namun risiko gangguan komunikasi antara operator di dalam silo dan petugas pengawas masih berada pada kategori *high*. Sebagai upaya pengendalian tambahan, diusulkan desain konseptual *Smart Confined Space Communication Earbud* sebagai media komunikasi khusus yang diharapkan dapat meningkatkan efektivitas komunikasi pada pekerjaan ruang terbatas dan berpotensi mengurangi kemungkinan terjadinya kegagalan komunikasi saat kondisi darurat.

Kata kunci: HIRADC, *risk matrix*, *confined space*, *engineering control*, *Smart Confined Space Communication Earbud*, *flour silo*.

ABSTRACT

Flour silo cleaning is a confined space activity with a high potential for occupational hazards, requiring effective risk management to prevent workplace accidents. One of the residual risks that remains at a high level is the communication barrier between operators working inside the silo and the standby personnel outside the silo. This study aimed to assess the level of risk associated with flour silo cleaning activities using the Hazard Identification, Risk Assessment and Determining Control (HIRADC) method based on a risk matrix and to develop risk control recommendations through an engineering control approach. This study employed a descriptive qualitative approach. Data were collected through field observations, interviews, documentation, and brainstorming sessions with company representatives. Hazard identification was conducted for every stage of the flour silo cleaning process, followed by risk assessment using likelihood and severity parameters based on a risk matrix. Risk control recommendations were developed according to the hierarchy of controls, followed by the development of a conceptual design for a Smart Confined Space Communication Earbud using Autodesk Fusion 360 as an engineering control proposal. The results showed that flour silo cleaning activities involve various hazards with risk levels ranging from low, medium, high, to extreme. Existing control measures successfully reduced most of the identified risks; however, the communication risk between workers inside the silo and the standby personnel remained at the high-risk level. As an additional engineering control, a conceptual design of the Smart Confined Space Communication Earbud was proposed to provide a dedicated communication device for confined space work. The proposed design is expected to improve communication effectiveness, facilitate faster information exchange during emergency situations, and reduce the likelihood of communication failure during flour silo cleaning activities.

Keywords: HIRADC, risk matrix, confined space, engineering control, Smart Confined Space Communication Earbud, flour silo..