**Project Title:** Fuel cells technology – part ٥-١: Revision of safety standard for portable fuel cells

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| ***Department:*** | Comprehensive plan for needs assessment, prioritization, development, revision, and supplementation of energy standards | ***Employer:*** | Niroo Research Institute |
| ***Project/Program Manager:*** | Mohammad Golmohammad | ***Executor:*** | Amir Sohrabi Kashani |
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**Keywords:** Fuel cell, Portable, Standard, Safety requirements. Commercial products. Technical requirement, Road map, Upstream documents.


**Project Necessity:**

Today, the energy crisis is rising and it is predicted that the energy consumption would be doubled to tripled by the end of the century. The shortcoming of fossil fuels sources along with global warming and environmental concerns lead to the introduction of new forms of renewable energies. Among those, hydrogen and fuel cells have attracted much attention in developed countries due to electricity production, cleanliness of energy, and transportation applications. Moreover, hydrogen and fuel cells technology can be coupled with other renewable energies like solar and biomass to produce clean and renewable energy.

Hydrogen produces water when burning and therefore is the best candidate to substitute gasoline. Developed countries such as the U.S, European countries, and Japan have a program plan to substitute hydrogen base fuel with fossil fuels by ٢٠٥٠. Therefore, European countries decided to invest ١,٣ B$ and DOE (U.S) put more than ١٢٠ M$ in ٢٠١٦ in hydrogen and fuel cells R&D to reach the aim by ٢٠٥٠.

Regarding this, standardizing this developing technology is a must. Different standards have been developed for these technologies. One of these standard cover portable fuel cell power system safety. It was first revised in ٢٠١٢ and was

then withdrawn in ۲۰۱۸. In Iran, INSO ۹۸۱٤-٥-۱ standard for portable fuel cell power systems was developed and is identical to IEC ٦٢٢٨٢-٥-١:٢٠١٢. Although, it needed to be revised regarding the new version of the IEC standard.

**Project Goals: Safety explanation of fuel cells with portable application**

۱. Studying the trends of portable fuel cells in Iran and worldwide along with conditions and related standards

۲. Preparing of national standard draft


**Abstract:**

One of the biggest challenges in the ۲۱st century is the energy demand increase due to population growth and the way of transition from fossil fuels to renewable energies. Among different renewable energies, hydrogen and fuel cells are a clean and renewable technology that gives the potential for hybridization with other technologies such as solar and biomass. The roadmap of the developed countries revealed that the trend is the substitution of fossil fuels with hydrogen fuels by ۲۰٥۰.

In this study, at first different types of fuel cells were studied and advantages and disadvantages were described. Afterward, the fuel cells with the potential candidate for portable applications such as proton exchange, direct methanol, and solid oxide fuel cells were studied thoroughly. The situation of other countries was presented and the commercialization steps with commercial products were introduced. The results revealed that numerous fuel cell companies are investing in research and development. As a result, one can predict that in near future, the new product would enter the market. The fuel cell market and the volume of the market are related to the political decision of governments which is more focused on transportation and can affect this technology significantly.

Surveying the activity of big companies in fuel cells reveals that the transportation and station applications are prior. For example, BALLARD and AVL have no activity in portable fuel cells. Although, in recent years multinational cooperation with the leading company located in the U.S. and Canada trying to open the market for portable fuel cells. The main application is in the military where different products are commercialized. It seems for portable fuel cells one can imagine different applications along with the military application.

Studying the roadmap of developed countries for fuel cells and hydrogen shows that the situation must change. Sooner or later huge effort would be performed for the manufacturing and commercialization of fuel cells. Also studying and comparing Iran's roadmap with other developed countries declare that this technology needs a lot of attention to compensate backwardness imposed.

Finally, the international standard of IEC ٦٦٢٨٢-٥-١٠٠ was studied and the national standard of ٩٨١٤-٥-١٠٠ was prepared. In this standard, the safety issue of portable fuel cells from production to use were presented. This standard after some procedure would be ready for approval by the Iranian standard organization.

**Steps and Methodologies:** (Font: Times New Roman ١٢)

For a better understanding of the recent development of fuel cell for portable application, first, different types of fuel cells and new improvement was surveyed. The fuel cells with the potential candidate for portable applications such as proton exchange, direct methanol, and solid oxide fuel cells were studied thoroughly To study the market, the commercialization steps of developed countries were studied. Then, commercial products were introduced. Afterward, regarding applications, the trend of technologies was discussed. For the determination of technical and safety requirements, the existing products were considered. As was mentioned, standards were determined for fuel cells in different applications in Iran and worldwide. Although, the standard of portable fuel cell power systems needs to be revised due to the development of technologies. Therefore, in this project, the mentioned standard would be revised identically with IEC ٦٢٢٨٢-٥-١٠٠: ٢٠١٨. Moreover, trends of development would be considered regarding Iran's situation.

**Main Results (technical outputs, patents, papers, books, reports, etc.):**

١. National standard number ٩٨١٤-٥-١٠٠
٢. Technical report of portable fuel cells