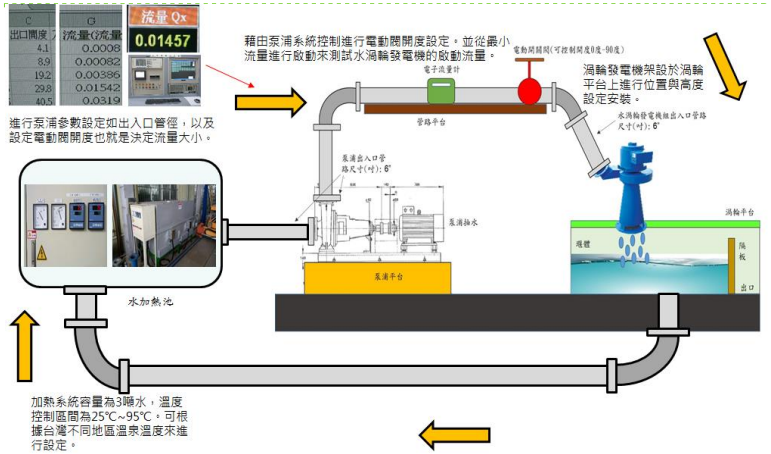
106年度「新及再生能源前瞻技術掃描評估及研發推動-地熱溫泉低流量發電模組探索創新前瞻計畫」

執行單位	財團法人金屬工業研究發展中心	計畫主持人	劉文鈞

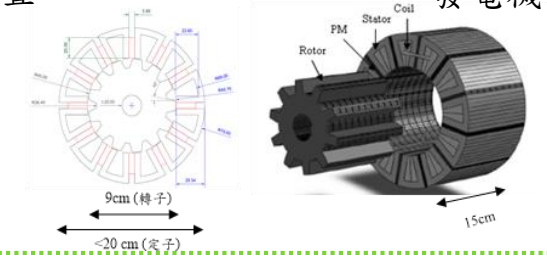
- 地熱溫泉低流量發電模組，非著重於傳統深層地熱發電，而是因應微型地熱溫泉水質、低於攝氏100度之溫度與小於0.05m^3/sec小流量低水頭等特徵，發展1kW等級之地熱溫泉新型發電模組創新設計分析、加工與場域對應測試技術。

1. 水渦輪葉片裝置
2. 微水力發電機
3. 緩啓動裝置、水渦輪發電機測試平台及水渦輪發電機組

水渦輪葉片裝置



緩啓動裝置、水渦輪發電機測試平台及水渦輪發電機組



微水力發電機

1. 水渦輪發電用微型渦輪組件開發:

- 完成水渦輪設計，以流量0.01-0.05 m^3/s與轉速800-1200 rpm之速度進行模擬分析，發現扭矩隨流量增加，由10.75N-M（0.03 m^3/s –1200rpm）增加至最高的54.7N-M（0.05 m^3/s – 800rpm）。符合計畫指標於流量≤ 0.05 m^3/s、水位差≤5m使用條件下，以葉輪直徑≤ 15cm之軸流式渦輪機模組達成輸出扭矩≥5N-M之要求。

2. 微型水渦輪匹配發電機設計與分析:

- 完成適於低轉速高扭力輸出之匹配磁通切換永磁發電機(FSPMG)新型設計，當流量0.03 m^3/s (渦輪輸出T=10.7N-m、轉速 1200 rpm、葉輪軸功1344 W)，發電機交流電功率~1190We、直流電壓VDC =23.4 V；流量0.05 m^3/s (渦輪輸出T=44.4N-m、轉速 1200 rpm、葉輪軸功5577 W)，發電機交流電功率~5199We。

3. 微型水渦輪發電機測試平台開發:

- 完成測試平台規劃與建置，執行成果符合計畫指標設定以地熱溫泉水力特徵，整合建置可調供水流量(0.02-0.05m^3/s)、溫度(25~70°C)及管路匹配(1.5~12吋)之微型水力發電模組測試平台，並可提供機組轉速與關鍵管路位置壓力、流量之即時監控與資料紀錄。

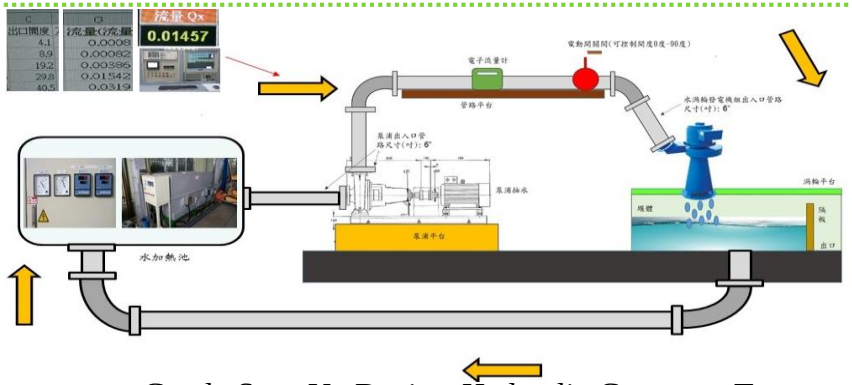
New and Renewable Energy Technology in Advanced Research and Development—Research Project of the Low Flow Rate Hot Spring Pico Hydroelectric Power Generation Module Technology

Execution Unit	Metal Industries Research & Development Centre
Project Director	Wen-Jiun Liu

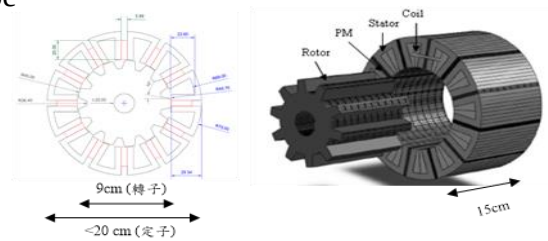
- A low flow rate power generation modules used for hot spring . Unlike those well-known traditional geothermal generators with high heat exchange efficiency character, this power module will use fountain water as its driven fluid which temperature below 100 degree Celsius and flow rate is less than 0.05 cubic meters per second, and the estimated maximum power output this power module will be near 1 Kilo watts.

1. Water Turbine Device
2. Pico Hydropower Generator
3. Gentle Start-Up Device, Hydraulic Generator Test Platform And Hydraulic Generator Set

Water Turbine Prototype



Gentle Start-Up Device, Hydraulic Generator Test Platform And Hydraulic Generator Set



Pico Hydropower Generator Structure Design

- Technology Brief :
  - Pico Hydropower Water Turbine, designed basically based on Kaplan type water wheel, could provide 54.7 N-M torque driven by 0.05m^3/s water flow rate.
  - Flux Reversed Power Generator(FSPG), has small volume sizes within 20x20x4 cm^3, could work in 1,200 RPM to generate DC 23.4 Volt, 5.199 kWe power output.
  - Simulated Hot Spring Condition Test Platform, built based on the hot spring related thermal and flow condition, could be used with adjustable water temperature 25~70℃ and flow rate 0.02-0.05m^3/s to obtain the operation characteristics of the pico hydropower modules.
- Achievement :
  - Establish a low flow rate hydropower generation module.
  - Validate the module performance on the test platform.
  - Investigate and make connection with the southern east Taiwan hot spring fields for future application collaboration.