Bibliografia

Abedin, A. Cogeneration systems: Balancing the heat power-ratio. *ASHRAE Journal*, 24-27, August 2003.

Agnew, B., Talbi, M. e Mostafavi, M. Combined power and cooling, an analysis of the combined Diesel-absorption cycle. *Applied Thermal Engineering*, vol. 19 (10), 1097-1105, 1999.

Akiyama, T., Matsumoto, H. e Asakura, K. Dynamic simulation and its applications to optimum operation support for advanced combined cycle plants. *Energy Conversion and Management*, vol. 38 (15-17), 1709-1723, 1997.

Alanne, K. e Saari, A. Sustainable small-scale CHP technologies for buildings: the basis for multi-perspective decision-making, *Renewable and Sustainable Energy Reviews*, vol. 8 (5), 401-431, 2004.

Babus'Haq, R. F. e Probert, S. D., Combined heat-and-power market-penetration in the UK: Problems and opportunities, *Applied Energy*, vol. 48 (4), 315-334, 1994.

Babus'Haq, R. F. e Probert, S. D., Combined heat-and-power implementation in the UK: Past, present and prospective developments, *Applied Energy*, vol. 53 (1-2), 47-76, 1996.

Bandyopadhyay, S., Bera, N. C. e Bhattacharyya, S. Thermoeconomic optimization of combined cycle power plants. *Energy Conversion and Management*, vol. 42 (3), 359-371, 2001.

Bassols, J., Buckelkorn, B., Langreck, J., Schneider, R. e Veelken, H. Trigeneration in the food industry, *Applied Thermal Engineering*, vol. 22 (6), 595-602, 2002.

Bejan, A. Advanced Engineering Thermodynamics. 2nd Ed. John Wiley & Sons, Inc. New York, NY. 1997.

Bidini, G., Desideri, U., Saetta, S. e Bocchini, P. P. Internal combustion engine combined heat and power plants: case study of the university of Perugia power plant. *Applied Thermal Engineering*, vol. 18 (6), 401-412, 1998.

Bojic, M. e Stojanovic, B., MILP optimization of a CHP energy system, *Energy Conversion and Management*, vol. 39, (7), 637-642, 1998.

Bonilla, D., Akisawa, A. e Kashiwagi, T. Modelling the adoption of industrial cogeneration in Japan using manufacturing plant survey data. *Energy Policy*, vol. 31 (9), 895-910, 2003.

Bourgeois, T.G., Hedman, B. e Zalcman, F., Creating markets for combined heat and power and clean distributed generation in New York State, *Environmental Pollution*, vol. 123 (3), 451-462, 2003.

Braun, R. J., Klein, S. A. e Reindl, D. T., Considerations in the Design and Application of Solid Oxide Fuel Cell Energy systems in Residential Markets. *ASHRAE Transactions: Research*, 14-24, 2004.

Brown, K. e Minett, S., History of CHP developments and current trends, *Applied Energy*, vol. 53 (1-2), 11-22, 1996.

Bruno, J. C., Miquel, J. e Castells, F. Modeling of ammonia absorption chillers integration in energy systems of process plants. *Applied Thermal Engineering*, vol. 19 (12) 1297-1328, 1999.

Burer, M., Tanaka, K., Favrat, D. e Yamada, K. Multi-criteria optimization of a district cogeneration plant integrating a solid oxide fuel cell–gas turbine combined cycle, heat pumps and chillers. *Energy*, vol. 28 (6), 497-518, 2003.

Buskies, U. The efficiency of coal-fired combined-cycle powerplants. *Applied Thermal Engineering*, vol. 16 (12), 959-974, 1996.

Caputo, A. C., Palumbo, M. e Scacchia, F., Perspectives of RDF use in decentralized areas: comparing power and co-generation solutions, *Applied Thermal Engineering*, In Press, 2004.

Cardona, E. e Piacentino, A. Cogeneration: a regulatory framework toward growth, *Energy Policy*, vol. 33 (16), 2100-2111, 2005.

Cardona, E. e Piacentino, A. A methodology for sizing a trigeneration plant in mediterranean areas. *Applied Thermal Engineering*, vol. 23 (13), 1665-1680, 2003a.

Cardona, E.e Piacentino, A. A measurement methodology for monitoring a CHCP pilot plant for an office building. *Energy and Buildings*, vol. 35 (9), 919-925, 2003b.

Cârdu, M. e Baica, M. About the ecological aspects of dual fuel combustion in thermopower plants. *Energy Conversion and Management*, vol. 44, 1773-1786. 2003.

CeGIBAT (Centre d'information de Gaz de France pour L'industrie et le Bâtiment)., Cogeneration using a turbine and a gas engine. *CeGIBAT*, 1998.

Çengel, Y. A., Boles, M. A., Thermodynamics, *Mc Graw Hill Inc.* New York, 1994.

COGEN. Cogeneration market prospects in Poland. *COGEN Eur. Newsl*., (03), 1998.

COGEN. Cogeneration & the EU policy makers. *COGEN Eur. Newsl*., n. 17, 2-4, 2000.

Colonna, P. e Gabrielli, S., Industrial trigeneration using ammonia–water absorption refrigeration systems (AAR), *Applied Thermal Engineering*, vol. 23 (4), 381-396, 2003.

Colpier, U. C. e Cornland, D., The economics of the combined cycle gas turbine––an experience curve analysis. *Energy Policy*, vol. 30 (4), 309-316, 2002.

Curti, V., von Spakovsky, M. R. e Favrat, D., An environomic approach for the modeling and optimization of a district heating network based on centralized and decentralized heat pumps, cogeneration and/or gas furnace. Part I: Methodology. *International Journal of Thermal Sciences*, vol. 39 (7), 721-730, 2000a.

Curti, V., Favrat, D. e von Spakovsky, M. R. An environomic approach for the modeling and optimization of a district heating network based on centralized and decentralized heat pumps, cogeneration and/or gas furnace. Part II: Application. *International Journal of Thermal Sciences*, vol. 39 (7) 731-741, 2000b.

d'Accadia, M. D. Optimal operation of a complex thermal system: a case study. *International Journal of Refrigeration*, vol. 24 (4), 290-301, 2001.

d'Accadia, M. D., Sasso, M., Sibilio, S. e Vanoli, L.. Micro-combined heat and power in residential and light commercial applications, *Applied Thermal Engineering*, vol. 23 (10), 1247-1259, 2003.

del Zoppo, A. New trends in Europe and worldwide: influence of the absorption machine. *Proc. Eur. Semin. Latest Technol. Refrig. Air Cond., Milano, IT.*, 2001.

de Witt, J. Development of gas engines for stationary applications (combined heat and power). *Fuel and Energy Abstracts*, vol. 37 (4), 292, 1996.

Dharmadhikari, S. Future role of industrial gas turbines. *Pet. Technol. Q.*, Spring, 119-125, 1998.

Dismukes, D. E. e Kleit, A. N. Cogeneration and electric power industry restructuring. *Resource and Energy Economics*, vol. 21 (2), 153-166, 1999.

Dossat, R. J. Principles of Refrigeration. 1st Ed. New York. Wiley. 1961.

Doiron, T. e Stoup, J. Uncertainty and dimensional calibrations. *Journal of Research of the Institute of Standards and Technology*, vol. 102 (6), 1997.

Eames, I. W. e Wu, S. Efficient use of waste heat from combined heating and power machines for building cooling. *Proc. SITHOK-3 Int. Congr., Maribor, SI.* 127-134, 1998.

Eastop, T. D. e McConkey, A. Applied Thermodynamics for Engineering Technologists. 5th Rev. Ed., Prentice-Hall. 1996.

Fantozzi, F., Ferico, S. D. e Desideri, U. Study of a cogeneration plant for agro-food industry. *Applied Thermal Engineering*, vol. 20 (11), 993-1017, 2000.

Few, P.C., Smith, M.A., Twidell, J.W., Modelling of a combined heat and power (CHP) plant incorporating a heat pump for domestic use, *Energy*, vol. 22 (7), 651-659, 1997.

Franco, A. e Casarosa, C. On some perspectives for increasing the efficiency of combined cycle power plants. *Applied Thermal Engineering*, vol. 22 (13), 1501-1518, 2002.

Franco, A. e Russo, A. Combined cycle plant efficiency increase based on the optimization of the heat recovery steam generator operating parameters. *International Journal of Thermal Sciences*, vol. 41 (9), 843-859, 2002.

Frangopoulos, C. A. e Dimopoulos, G. G. Effect of reliability considerations on the optimal synthesis, design and operation of a cogeneration system. *Energy*. Vol. 29 (3), 309-329, 2004.

Gamou, S., Yokoyama, R. e Ito, K. Optimal unit sizing of cogeneration systems in consideration of uncertain energy demands as continuous random variables. *Energy Conversion and Management*, vol. 43 (9-12), 1349-1361, 2002.

Greene, A.B. e Lucas, G.G., Testing of Internal Combustion Engines, The English University Press Limited, London, 1969.

Grohnheit, P. E. e Mortensen, B.O.G., Competition in the market for space heating. District heating as the infrastructure for competition among fuels and technologies, *Energy Policy*, vol. 31 (9), 817-826, 2003.

Gunes, M. B. e Ellis, M. W. Evaluation of energy, environmental, and economic characteristics of fuel cell combined heat and power systems for residential applications. *Journal of Energy Resources Technology - Transactions of the ASME*, vol. 125 (3), 208-220, 2003.

Gunzbourg, J. de e Larger, D. Cogeneration applied to very high efficiency thermal seawater desalination plants. *Desalination*, vol. 125 (1-3), 203-208, 1999.

Hendriks, C. e Blok, K., Regulation for combined heat and power in the European union, *Energy Conversion and Management*, vol. 37 (6-8), 729-734, 1996.

Hernández-Santoyo, J. e Sánchez-Cifuentes, A., Trigeneration: an alternative for energy savings, *Applied Energy*, vol. 76 (1-3), 219-227, 2003.

Héteu, P.M.T., Bolle, L., Economie d´énergie en trigénération (Energy saving with trigeneration), *International Journal of Thermal Sciences*, vol. 41, 1151-1159, 2002.

Hughes, E. Biomass cofiring: economics, policy and opportunities. *Biomass and Bioenergy*, vol. 19 (6), 457-465, 2000.

IOS. *International Vocabulary of basic and general terms in metrology*, Geneva, Switzerland, 1995.

Jaber, D. e Vetterick, R. Reliable systems and combined heat and power. *Steam Digest 2001*, U.S. Department of Energy, Energy Efficiency and Renewable Energy, Industrial Technologies Program, 2001.

Jóvaj, M.S. e Máslov, G.S. Motores de automóvil. Editorial Pueblo y Educación. La Habana. 1978.

Knowles, J. Air CHP as a total energy system for Royal Mail. *Proc. CIBSE, Natl. Conf., London, GB.*, vol. 2, 138-147, 1997a.

Knowles, J. Combined heat and power system. *Applied Thermal Engineering*, vol. 17 (2), XI, 1997b.

Kong, X. Q., Wang, R. Z. e Huang, X. H., Energy efficiency and economic feasibility of CCHP driven by stirling engine, Energy Conversion and Management, vol. 45 (9-10), 1433-1442, 2004.

Kotas, T. J. The exergy method of thermal plat analysis. Anchor Brendon Ltd., Tiptree, Essex, Reino Unido, 1985.

Kwak, H. Y., Kim, D. J. e Jeon, J. S. Exergetic and thermoeconomic analyses of power plants. *Energy*, vol. 28 (4), 343-360, 2003.

Langreck, J. Cogen-absorption plants for refrigeration purposes and turbine air inlet cooling. *Cogener. On Site Power Prod.*, vol. 1 (2), 46-49, 2000.

Lazzarin, R. M., Longo, G. A. e Romagnoni, P. C. A new HVAC system based on cogeneration by an I.C. engine. *Applied Thermal Engineering*, vol. 16 (7), 551-559, 1996.

Lazzarin, R. M., e Gasparella, A. New ideas for energy utilisation in combined heat and power with cooling: I. Principles, *Applied Thermal Engineering*, vol. 17 (4), 369-384, 1997.

Lemar, L. Jr., The potential impact of policies to promote combined heat and power in US industry, *Energy Policy*, vol. 29 (14), 1243-1254, 2001.

Lemmon, E. W., McLinden, M. O. e Huber, M. L., NIST Reference Fluid Thermodynamic and Transport Properties – REFPROP, version 7.0, Physical and Chemical Properties Division, NIST – National Institute of Standards and Technology, Boulder, USA, 2002.

Lin, F., Yi, J., Weixing, Y. e Xuzhong, Q. Influence of supply and return water temperatures on the energy consumption of a district cooling system, Short Communication. *Applied Thermal Engineering*, vol. 21 (4), 511-521, 2001.

Lindenberger, D., Bruckner, T., Groscurth, H. M. e Kümmel, R. Optimization of solar district heating systems: seasonal storage, heat pumps, and cogeneration. *Energy*, vol. 25 (7), 591-608, 2000.

Lucas, K. Efficient energy systems on the basis of cogeneration and heat pump technology. *International Journal of Thermal Sciences*, vol. 40 (4), 338-343, 2001.

Maidment, G. G. e Tozer, R. M., Combined cooling heat and power in supermarkets, *Applied Thermal Engineering*, vol. 22 (6), 653-665, 2002.

Maldague, P. E., Combined heat and power (CHP) vs separate heat and power (SHP) generation for primary energy conservation, *Journal of Heat Recovery Systems*, vol. 4 (5), 337-340, 1984.

Mansour, C., Bounif, A., Aris, A. e Gaillard, F., Gas–Diesel (dual-fuel) modeling in Diesel environment. *Int. Journal of Thermal Sciences.* vol. 40, 409-424, 2001.

Mashimo, K. e Ikumi, Y. Absorption system in combined heat and power. *Proc. Of the IEA Annex 24 Workshop. Tokio, Japan*, HPP-AN24-2, 173-186, 1998.

Míguez, J.L., Murillo, S., Porteiro, J., López, L.M., Feasibility of a new domestic CHP trigeneration with heat pump: I. Design and development, *Applied Thermal Engineering*, vol. 24, 1409-1419, 2004.

Minciuc, E., Corre, O.L. Athanasovici, V., Tazerout, M. e Bitir, I., Thermodynamic analysis of tri-generation with absorption chilling machine, *Applied Thermal Engineering*, vol. 23 (11), 1391-1405, 2003.

Mohanty, B. e Panda, H., Integrated energy system for industrial complexes. Part I: A linear programming approach, *Applied Energy*, vol. 46 (4), 317-348, 1993.

Mostafavi, M. e Agnew, B., Thermodynamic analysis of combined Diesel engine and absorption unit--turbocharged engine with intercooling, *Applied Thermal Engineering*, vol. 16 (8-9), 733-740, 1996a.

Mostafavi, M. e Agnew, B., Thermodynamic analysis of combined Diesel engine and absorption unit--turbocharged engine, *Applied Thermal Engineering*, vol. 16 (10), 845-850, 1996b.

Mostafavi, M. e Agnew, B., Thermodynamic analysis of combined Diesel engine and absorption refrigeration unit--supercharged engine with intercooling, *Applied Thermal Engineering*, vol. 16 (11), 921-930, 1996c.

Mostafavi, M. e Agnew, B., Thermodynamic analysis of combined Diesel engine and absorption refrigeration unit--naturally aspirated Diesel engine, *Applied Thermal Engineering*, vol. 17 (5), 471-478, 1997.

Mostafavi, M., Alaktiwi, A. e Agnew, B., Thermodynamic analysis of combined open-cycle-twin-shaft gas turbine (Brayton cycle) and exhaust gas operated absorption refrigeration unit, *Applied Thermal Engineering*, Volume 18 (9-10), 847-856, 1998.

Najjar, Y. S. H. e Akyurt, M. Combined cycles with gas turbine engines. *Heat Recovery Systems and CHP*, vol. 14 (2), 93-103, 1994.

Najjar, Y. S. H. Comparison of performance of the integrated gas and steam cycle (IGSC) with the combined cycle (CC). *Applied Thermal Engineering*, vol. 19 (1), 75-87, 1999.

Najjar, Y. S. H. Efficient use of energy by utilizing gas turbine combined systems. *Applied Thermal Engineering*, vol. 21 (4), 407-438, 2001.

Oliveira, A. C., Afonso, C. e Matos, J. A combined heat and power system for buildings driven by solar energy and gas. *Appl. Therm. Eng.*, vol. 22 (6), 587-593, 2002.

Pak, P. S. e Suzuki, Y. Exergetic evaluation of gas turbine cogeneration systems for district heating and cooling. *Int. J. Energy Res*., vol. 21 (3), 209-220, 1997a.

Pak, P. S. e Suzuki, Y. Exergetic evaluation of methods for improving power generation efficiency of a gas turbine cogeneration system. *Int. J. Energy Res*., vol. 21 (8), 737-747, 1997b.

Parise, J. A. R. e Cartwright, W. G. Experimental analysis of a Diesel engine driven water-to-water heat pump. *Heat Recovery Systems and CHP*, vol. 8 (2), 75-85, 1988.

Parise, J. A. R., Vargas, J. V. C., Marques, R. P. Fuel Cells and Cogeneration, *Third International Conference on Fuel Cell Science Engineering and Technology*, Yipsilanti, *MI, USA*, May 23-23, 2005.

Paul, J. e Jahn, E. Cogeneration of energy with gas turbines. *Proc. EPRI Int. Conf. Sustainable TES, Minneapolis, US.* 151-154, 1996.

Phillips, S. D. Performance Evaluations In: Bosch, J. A. - *Coordinate Measuring Machines and Systems*. New York: Marcel Dekker, 1995.

Porteiro, J., Míguez, J. L., Murillo, S. e López, L. M., Feasibility of a new domestic CHP trigeneration with heat pump: II. Availability analysis, *Applied Thermal Engineering*, vol. 24 (10), 1421-1429, 2004.

Qin, W., Egolfopoulos, F. N. e Tsotsis, M. T. T. Fundamental and environmental aspects of landfill gas utilization for power generation. *Chemical Engineering Journal*, vol. 82 (1-3), 157-172, 2001.

Rizy, D.T., Zaltash, A., Labinov, S.D., Petrov, A.Y., Vineyard, E.A., Linkous, R.L., CHP integration (or IES): Maximizing the efficiency of distributed generation with waste heat recovery, Report, Oak Ridge National Laboratory, Oak Ridge, USA, 2001.

Rizy, D.T., Zaltash, A., Labinov, S.D., Petrov, A.Y., Fairchild, P., Integration of distributed energy resources and thermally-activated technologies, Proceedings of the DistribuTECH Conference, February 27-March 1, Miami, USA, 2002.

Rodrigues, M., Walter, A. e Faaij, A. Co-firing of natural gas and Biomass gas in biomass integrated gasification/combined cycle systems. *Energy*, vol. 28 (11), 1115-1131, 2003.

Rolfsman, B., Combined heat-and-power plants and district heating in a deregulated electricity market, *Applied Energy*, vol. 78 (1), 37-52, 2004.

Roosen, P., Uhlenbruck, S. e Lucas, K. Pareto optimization of a combined cycle power system as a decision support tool for trading off investment vs. operating costs. *International Journal of Thermal Sciences*, vol. 42 (6), 553-560, 2003.

Sciubba, E. Cost analysis of energy conversion systems via a novel resource-based quantifier. *Energy*, vol. 28 (5), 457-477, 2003.

Silveira, J. L., Walter, A. C. S. e Luengo, C. A., A case study of compact cogeneration using various fuels. *Fuel*, vol. 76 (5), 447-451, 1997.

Silvetti, B. An electric/natural gas/thermal storage hybrid as an alternative to engine-driven chillers. *Proc. EPRI Int. Conf. Sustainable TES, Minneapolis, US.*102-106, 1996.

Shin, J. Y., Jeon, Y. J., Maeng, D. J., Kim, J. S. and Ro, S. T. Analysis of the dynamic characteristics of a combined-cycle power plant. *Energy*, vol. 27 (12), 1085-1098, 2002.

Smith, M.A., Few, P.C., Domestic-scale combined heat-and-power system incorporating a heat pump: analysis of a prototype plant, *Applied Energy*, vol. 70, 215-232, 2001.

Soares, J. B., Szklo, A. S. e Tolmasquim, M. T. Incentive policies for natural gas-fired cogeneration in Brazil's industrial sector — case studies: chemical plant and pulp mill. *Energy Policy*, vol. 29 (3), 205-215, 2001.

Swanson, J. E. Prime movers reduce energy costs. *Fuel and Energy Abstracts*, vol. 37 (5), 358, 1996.

Szklo, A. S., Soares J. B. e Tolmasquim M. T., Energy consumption indicators and CHP technical potential in the Brazilian hospital sector, *Energy Conversion and Management*, vol. 45 (13-14), 2075-2091, 2004.

Temir, G. e Bilge, D. Thermoeconomic analysis of a trigeneration system, *Applied Thermal Engineering*, vol. 24 (17-18), 2689-2699, 2004.

Valdés, M. e Rapún, J. L. Optimization of heat recovery steam generators for combined cycle gas turbine power plants. *Applied Thermal Engineering*, vol. 21 (11), 1149-1159, 2001.

Vedamurthy, V. N. e Sarathy, C. P. A techno-economic model for determining the critical energy ratio of co-generation in process industries. *Mathematical and Computer Modelling*, vol. 14, 1117-1122, 1990.

Watt, G. M. Gas cooling in Australia: past, present and future. *Ecolibrium*, vol. 1 (2), 26-32, 2002.

Wigley, T. M. L., The Kyoto Protocol: CO_2, CH_4 and Climate implications, *Geophysical Research Letters*, vol. 25, (13), 2285, 1998.

Wimberly J. J., Long S. W. e Dyer J. B. Gas cogeneration systems are making headway in non traditional cogeneration areas. *ASHRAE Trans*., vol. 2 (1), 775-783, 1996.

Zhu, R., Han, B., Lin, M. e Yu, Y. Experimental investigation on an adsorption system for producing chilled water. *International Journal of Refrigeration*, vol. 15 (1), 31-34, 1992.

Apêndice A 1 – Programas para pré–processamento dos dados.

LABREF 01 (código em Visual Basic)**:** Da Planilha de *Excel* criada pela exportação dos dados adquiridos durante o teste: elimina as colunas desnecessárias, habilita os dados para compatibilizar as unidades de medição, reduz o número de dados (para facilitar manuseio dos dados e gráficos) fazendo a média da quantidade necessária de dados para que no final fique um número predeterminado (ex. 200).

LABREF 02 (código em Visual Basic)**:** Seleciona os dados necessários para os cálculos do ciclo de refrigeração.

LABREF 03 (código em Visual Basic)**:** Cria um arquivo com os dados obtidos. Manda correr o programa *BancaRefrig*, espera o sinal de parada do programa *BancaRefrig*, lê o arquivo criado por *BancaRefrig* e coloca os dados calculados na planilha de *Excel* de origem.

BANCAREFRIG (código em *FORTRAN* que usa as sub-rotinas e funções do *REFPROP*): Lê o arquivo criado por *CriaArquivoTexto* e calcula o ciclo de refrigeração. Cria um arquivo de texto com o resultado dos cálculos.

LABREF 01

```
Sub LABREF_01()

' Macro gravada em 26/4/2004 por PRUZA

' INICIALIZACIÓN

Dim LastRow, NumRows, a, cont, cellini As Integer
Dim linha, mmm, nnn, ttt, b, C, i, j, k  As Integer
Dim SomaCol(31), ColTemp(31) As Double
Dim PlanName As Variant

PlanName = ActiveSheet.Name  'nome da planilha onde se
realiza a operação
```

```
' ELIMINACIÓN DE LAS COLUNAS SOBRANTES

For i = 3 To 31
    For j = 1 To 2
        Columns(i + 1).Select
        Selection.Delete
    Next
Next

' PROCURAR FIN DEL ARCHIVO (LÍNEA FINAL)

a = 0
cont = 0
' cuenta las células vacías al final de una columna.
' si cont = 10 then end of file (EOF)

    Do While cont <> 2
        a = a + 1
        Cells(a, 2).Select
        LastRow = ActiveCell.Row
        ActiveSheet.Cells(1, 2) = LastRow

        If ActiveCell.Value = "" Then cont = cont + 1
    Loop

        NumRows = LastRow - 4

' dos lineas de "contador", una de "cabeçalho" y una
del segundo (instante) "zero" que va a ser eliminado

        Cells(1, 2).Select

' DIVISIÓN DE LAS CELULAS PARA OBTENER LOS VALORES
REALES DE LA LECTURA

' NumRows ... nro de filas da coluna
' colnum  ... nro da coluna a operar
' cellini ... nro da fila onde começa a operação

factor1 = 1 / 1000
factor2 = 1 / 1000000

cellini = 3
colnum = 2

For i = cellini To NumRows
    aaa = ActiveSheet.Cells(i, colnum)
    ActiveSheet.Cells(i, colnum) = aaa * factor1
Next

For j = 3 To 31
    For i = cellini To NumRows
    aaa = ActiveSheet.Cells(i, j)
    ActiveSheet.Cells(i, j) = aaa * factor2
    Next
Next
```

```
' ELIMINACIÓN DEL SEGUNDO "ZERO"

    Rows(2).Select
    Selection.Delete

' FORMATACIÓN DE LAS CÉLULAS DE LA PLANILLA

For j = 2 To 31
    For i = 2 To 205

    Cells(i, j).Select
    ActiveCell.NumberFormat = "0.00"

    Next
Next

'            ActiveSheet.Name = PlanName + "WORKED"
'    Copiar la columna del canal 214 para la del 206
(Dry Bulb Temperature)

For i = 2 To 205

    ActiveSheet.Cells(i, 24) = Cells(i, 31)

Next

End Sub
```

LABREF 02

```
Sub LABREF_02()

' Macro gravada em 27/4/2004 por guest

For i = 1 To 205

    Worksheets("Plan2").Cells(i     +     3,     2)     =
Worksheets("Plan1").Cells(i + 1, 11)
    Worksheets("Plan2").Cells(i     +     3,     3)     =
Worksheets("Plan1").Cells(i + 1, 12)
    Worksheets("Plan2").Cells(i     +     3,     4)     =
Worksheets("Plan1").Cells(i + 1, 17)
    Worksheets("Plan2").Cells(i     +     3,     5)     =
Worksheets("Plan1").Cells(i + 1, 27)
    Worksheets("Plan2").Cells(i     +     3,     6)     =
Worksheets("Plan1").Cells(i + 1, 28)
    Worksheets("Plan2").Cells(i     +     3,     7)     =
Worksheets("Plan1").Cells(i + 1, 26)
    Worksheets("Plan2").Cells(i     +     3,     8)     =
Worksheets("Plan1").Cells(i + 1, 25)

Next

End Sub
```

LABREF 03

```
Option Explicit

Dim DemoDirectory$

Private Const SYNCHRONIZE = &H100000
Private Const INFINITE = &HFFFFFFFF
Private Declare Function OpenProcess Lib "Kernel32" _
              (ByVal  dwDesiredAccess  As  Long,  ByVal
bInheritHandle As Long, _
                                              ByVal
dwProcessId As Long) As Long
Private Declare Function CloseHandle Lib "Kernel32" _
              (ByVal hObject As Long) As Long
Private   Declare   Function   WaitForSingleObject   Lib
"Kernel32" _
              (ByVal    hHandle    As    Long,    ByVal
dwMilliseconds As Long) As Long
'Private   Declare   Function   CreateProcessBynum   Lib
"Kernel32" _
 '                      Alias  "CreateProcessA"  (ByVal
lpApplicationName As String, _
  '                ByVal lpCommandLine As String, ByVal
lpProcessAttributes As Long, _
   '             ByVal lpTheadAttributes As Long, ByVal
bInheritHandles As Long, _
    '                   ByVal  dwCreationFlags  As  Long,
lpEnvironment As Any, ByVal _
     '                  lpCurrentDirectory  As  String,
lpStartupInfo As STARTUPINFO, _
      '                           lpProcessInformation   As
PROCESS_INFORMATION) As Long
Private Declare Function WaitForInputIdle Lib "user32"
(ByVal hProcess As Long, _
              ByVal dwMilliseconds As Long) As Long
Private Declare Function ShellExecute Lib "shell32.dll"
Alias "ShellExecuteA" _
              (ByVal hwnd As Long, ByVal lpOperation As
String, ByVal lpFile _
              As String, ByVal lpParameters As String,
ByVal lpDirectory As _
              String, ByVal nShowCmd As Long) As Long
```

```
Sub LABREF_03()

' Macro gravada em 27/4/2004 por guest
'
Dim   PEntComp(210),   PSaiComp(210),   PSaiCond(210),
PEntEvap(210) As Double
Dim  TEntComp(210),  TSaiCond(210),  TSaiComp(210)  As
Double
Dim   HEntComp(210),   HEntCond(210),   HSaiCond(210),
HEntEvap(210) As Double
Dim HCompIst(210), dTsaq(210), dTsbr(210) As Double
```

```
Dim ErroEnt(210) As String

Dim MyFile, MyFileSai, PathdeMyFile As String
Dim i, j As Integer

    For i = 1 To 210

        TEntComp(i) = ActiveSheet.Cells(i + 3, 2)
        TSaiComp(i) = ActiveSheet.Cells(i + 3, 3)
        TSaiCond(i) = ActiveSheet.Cells(i + 3, 4)
        PEntComp(i) = ActiveSheet.Cells(i + 3, 5)
        PSaiComp(i) = ActiveSheet.Cells(i + 3, 6)
        PSaiCond(i) = ActiveSheet.Cells(i + 3, 7)
        PEntEvap(i) = ActiveSheet.Cells(i + 3, 8)

    Next

    PathdeMyFile        =        "C:\Documents        and
Settings\guest\Meus Documentos\"

    MyFile = "MyText.txt"

    Open PathdeMyFile + MyFile For Output As #2

        For i = 1 To 210

    Write #2, TEntComp(i)
    Write #2, TSaiComp(i)
    Write #2, TSaiCond(i)
    Write #2, PEntComp(i)
    Write #2, PSaiComp(i)
    Write #2, PSaiCond(i)
    Write #2, PEntEvap(i)

        Next

    Close #2

'*******************************************************

    Call MandaCorrerExterno

'*******************************************************
    MyFileSai = "MyOtherText.txt"

    Open PathdeMyFile + MyFileSai For Input As #2

        For i = 1 To 205

        Input #2, HEntComp(i)
        Input #2, HEntCond(i)
        Input #2, HSaiCond(i)
        Input #2, HEntEvap(i)
        Input #2, HCompIst(i)
        Input #2, dTsaq(i)
        Input #2, dTsbr(i)
        Input #2, ErroEnt(i)
```

```
        Next
    Close #2

        For j = 1 To 205

        ActiveSheet.Cells(j + 3, 9) = HEntComp(j)
        ActiveSheet.Cells(j + 3, 10) = HEntCond(j)
        ActiveSheet.Cells(j + 3, 11) = HSaiCond(j)
        ActiveSheet.Cells(j + 3, 12) = HEntEvap(j)
        ActiveSheet.Cells(j + 3, 13) = HCompIst(j)
        ActiveSheet.Cells(j + 3, 14) = dTsaq(j)
        ActiveSheet.Cells(j + 3, 15) = dTsbr(j)
        ActiveSheet.Cells(j + 3, 16) = ErroEnt(j)

        Next

End Sub

'*********************************************************

Private Sub Gatilho()

'FrmInterFace.Left = 11730
'FrmInterFace.Top = 6615

Dim pid&

'lblStatus.Caption = "Launching..."
'lblStatus.Refresh

DemoDirectory = "C:\REFPROP\BancaEntalpia\Debug\"

pid   =   Shell(DemoDirectory   &   "BancaEntalpia.exe",
vbNormalFocus)

If pid <> 0 Then
'    lblStatus.Caption = "Launched"
'    lblStatus.Refresh
    WaitForTerm1 pid
End If

'lblStatus.Caption = "terminated"

'FrmInterFace.Left = 6255
'FrmInterFace.Top = 2760
'FrmInterFace.SetFocus
'FrmInterFace.Show
'FrmInterFace.Visible = True

End Sub

Private Sub WaitForTerm1(pid&)

Dim phnd&

phnd = OpenProcess(SYNCHRONIZE, 0, pid)
```

```
If phnd <> 0 Then
        'lblStatus.Caption      =      "Waiting      For
Termination..."
        'lblStatus.Refresh
        Call WaitForSingleObject(phnd, INFINITE)
        Call CloseHandle(phnd)
End If

End Sub

'******************************************************

Public Sub MandaCorrerExterno()

' MandaCorrerExterno Macro
' Macro gravada em 30/4/2004 por guest

Call Gatilho

End Sub
'******************************************************
```


BANCAREFRIG

```
     program BANCAREFRIG
c
c*******************************************************
c    Frank C. Pruzaesky, MSc. Eng.
c    Pontifícia Universidade Católica do Rio de Janeiro
c    Depto de Engenharia Mecânica
c    Laboratório de Refrigeração e Aquecimento
c*******************************************************
c
c    TEnt : temperatura à entrada do dispositivo
c    TSai : temperatura à saída do dispositivo
c    PEnt : pressão à entrada do dispositivo
c    PSai : pressão à saída do dispositivo
c    HEnt : entalpia à entrada do dispositivo
c    HSai : entalpia à saída do dispositivo
c
c    Dispositivos: COMPressor, CONDensador, EVAPorador
c
     Implicit double precision (a-h, o-z)
     Implicit integer (i-n)

     double precision mmlr
parameter (ncmax=5)
!dimension for compositions, etc.
character*80 hfiles(ncmax),hfmix
!files with fluid and mix data
character*3 hrf
!reference state specification
Character*4 ref
character*255 herr
```

```
!error string output by routines
character*12 hfluid(ncmax)
character*12 hcas(ncmax),hname(ncmax)
character*80 hn80
character*1 erroent
dimension x(ncmax),xkg(ncmax)
dimension TEntComp(210), TSaiComp(210), TSaiCond(210),
+            PEntComp(210),              PSaiComp(210),
PSaiCond(210), PEntEvap(210),
+       HEntComp(210),   HEntCond(210),   HSaiCond(210),
HEntEvap(210),
+       HCompIst(210),      dTsaq(210),      dTsbr(210),
erroent(210)


     Call Inicializa (ref,nc,hfiles,hfmix,hrf,X,mmlr,
+               TEntComp, TSaiComp, TSaiCond, PEntComp,
+                      PSaiComp, PSaiCond, PEntEvap)

     Call TempConvert (TEntComp, TSaiComp, TSaiCond)

     Call  PressConvert  (PEntComp,  PSaiComp,  PSaiCond,
PEntEvap)

     Call  EntalpiaCal  (TEntComp,  TSaiComp,  TSaiCond,
PEntComp,   PSaiComp,   PSaiCond,   PEntEvap,   HEntComp,
HEntCond, HSaiCond, HEntEvap, HCompIst, erroent, mmlr)

     Call   DTcal   (TEntComp,   PEntEvap,   PEntComp,
TSaiCond, PSaiComp, PSaiCond, dTsaq, dTsbr)

     Call  Resultados  (HEntComp,  HEntCond,  HSaiCond,
HEntEvap, HCompIst, dTsaq, dTsbr, erroent)

     end

*********************************************

subroutine inicializa (ref,nc,hfiles,hfmix,hrf,X,mmlr,
TEntComp,   TSaiComp,   TSaiCond,   PEntComp,   PSaiComp,
PSaiCond, PEntEvap)
c
c         Modificado 03 / 06 / 2004
c
c*****************************************************
c    MSc. Frank C. Pruzaesky
c    Pontifícia Universidade Católica do Rio de Janeiro
c    Depto de Engenharia Mecânica
c    Laboratório de Refrigeração e Aquecimento
c*****************************************************

      implicit double precision (a-h,o-z)
      implicit integer (i-n)

      double precision mmlr

      parameter (ncmax=5)
!dimension for compositions, etc.
```

```
      character*80 hfiles(ncmax),hfmix
!files with fluid and mix data
      character*3 hrf
!reference state specification
      character*4 ref
      character*255 herr
!error string output by routines
      character*12 hfluid(ncmax)
      character*12 hcas(ncmax),hname(ncmax)
      character*80 hn80

      character*48 PathdelFile
      character*10 files

dimension x(ncmax),xkg(ncmax)

dimension TEntComp(210), TSaiComp(210), TSaiCond(210),
+ PEntComp(210), PSaiComp(210), PSaiCond(210),
+ PEntEvap(210)

c    Seleção do Refrigerante e "propriedades" para
programar com o REFPROP

     Call REFESC    (ref,nc,hfiles,hfmix,hrf,X,mmlr)

PathdelFile  =  'C:\Documents  and  Settings\guest\Meus
documentos\'

     files = 'MyText.txt'
c
      OPEN(2, FILE=PathdelFile//files, STATUS='OLD')
c
     do i = 1, 205

          read (2,*) TEntComp(i)
          read (2,*) TSaiComp(i)
          read (2,*) TSaiCond(i)
          read (2,*) PEntComp(i)
          read (2,*) PSaiComp(i)
          read (2,*) PSaiCond(i)
          read (2,*) PEntEvap(i)

     enddo

     close (2)
     return
     end

c*******************************************************

     subroutine REFESC (ref,nc,hfiles,hfmix,hrf,X,mmlr)

c*******************************************************
c    MSc. Frank C. Pruzaesky
c    Pontifícia Universidade Católica do Rio de Janeiro
c    Depto de Engenharia Mecânica
c    Laboratório de Refrigeração e Aquecimento
```

```
c*******************************************************
c      The following declarations are needed to use the
c                       Refprop6 routines
c
      implicit double precision (a-h,o-z)
      implicit integer (i-n)
      double precision mmlr
      parameter (ncmax=5)
!dimension for compositions, etc.
      character*80 hfiles(ncmax),hfmix
!files with fluid and mix data
      character*3 hrf
!reference state specification
      character*2 ref
      character*255 herr
!error string output by routines
      character*12 hfluid(ncmax)
      character*12 hcas(ncmax),hname(ncmax)
      character*80 hn80
      dimension x(ncmax),xkg(ncmax)
c
     ref = '22'
c
c      Using refprop with "nc = 1" fluids
c
     NC = 1
c
     X(1)= 1.0d0
c
     hfluid(1) = 'R'//ref//'.fld'
c
      hfiles(1)='C:\REFPROP\FLUIDS\'//hfluid(1)
      hfmix='C:\REFPROP\FLUIDS\'//'HMX.bnc'        !
created by compiling)
c
      hrf='IIR'
c
     xkg(1) = 1.0d0
c
c    call to SETUP accepting all default models for EOS
c
     call SETUP (nc,hfiles,hfmix,hrf,ierr,herr)

     call ERRMSG (ierr,herr)
     call XMOLE (xkg,x,wmm)
!wmm=molecular weight of fluid

          mmlr = WMOL(X)
c
       call NAME (i,hname,hn80,hcas)
       call                                          INFO
(i,wm,ttp,tnbp,tcrit,pcrit,Dcrit,Zc,acf,dip,Rgas)

return

end
```

```
c*******************************************************

      subroutine   TempConvert   (TEntComp,   TSaiComp,
TSaiCond)

c*******************************************************
c     MSc. Frank C. Pruzaesky
c     Pontifícia Universidade Católica do Rio de Janeiro
c     Depto de Engenharia Mecânica
c     Laboratório de Refrigeração e Aquecimento
c*******************************************************
c
       implicit double precision (a-h,o-z)
       implicit integer (i-n)

dimension TEntComp(210), TSaiComp(210), TSaiCond(210)

c     converte de °C a K

      do i=1, 205

      TEntComp(i) = TEntComp(i) + 273.15d0
      TSaiComp(i) = TSaiComp(i) + 273.15d0
      TSaiCond(i) = TSaiCond(i) + 273.15d0

      enddo

      return
      end

c*******************************************************

subroutine PressConvert (PEntComp, PSaiComp, PSaiCond,
PEntEvap)


c*******************************************************
c     MSc. Frank C. Pruzaesky
c     Pontifícia Universidade Católica do Rio de Janeiro
c     Depto de Engenharia Mecânica
c     Laboratório de Refrigeração e Aquecimento
c*******************************************************
c
       implicit double precision (a-h,o-z)
       implicit integer (i-n)

dimension PEntComp(210), PSaiComp(210), PSaiCond(210),
     +                                    PEntEvap(210)

c     convierte de PSI manométrica a kPa absoluta (el
REFPROP trabaja con presión absoluta!!!!)

      Factor = 6.894757293

      do i=1, 205

PEntComp(i) = ( PEntComp(i) + 14.50377377 ) * Factor
```

```
PSaiComp(i) = ( PSaiComp(i) + 14.50377377 ) * Factor
PSaiCond(i) = ( PSaiCond(i) + 14.50377377 ) * Factor
PEntEvap(i) = ( PEntEvap(i) + 14.50377377 ) * Factor

     enddo

     return
end

c*******************************************************
     subroutine   EntalpiaCal   (TEntComp,   TSaiComp,
TSaiCond, PEntComp,
+     PSaiComp, PSaiCond, PEntEvap, HEntComp, HEntCond,
+     HSaiCond, HEntEvap, HCompIst, erroent, mmlr)

c*******************************************************
c    MSc. Frank C. Pruzaesky
c    Pontifícia Universidade Católica do Rio de Janeiro
c    Depto de Engenharia Mecânica
c    Laboratório de Refrigeração e Aquecimento
c*******************************************************
c
      implicit double precision (a-h,o-z)
      implicit integer (i-n)
      double precision mmlr

      parameter (ncmax=5)
!dimension for compositions, etc.
      character*3 hrf
!reference state specification
      character*255 herr
!error string output by routines

      character*1 erroent

dimension         x(ncmax),         z(ncmax),xkg(ncmax),
xl(ncmax),yv(ncmax)

dimension TEntComp(210), TSaiComp(210), TSaiCond(210),
+      PEntComp(210), PSaiComp(210), PSaiCond(210),
+      PEntEvap(210), HEntComp(210), HEntCond(210),
+      HSaiCond(210), HEntEvap(210), HCompIst(210),
+           erroent(210)

     x(1) = 1.0d0
     z(1) = 1.0d0

     factor = 1.0d0 / mmlr

     do i = 1, 205

c    HEntComp

     T = TEntComp(i)
     P = PEntComp(i)

     call TPFLSH (T, P, X, D, Dl, Dv, xl, yv, q, e, h,
SEntComp, cv, cp, w, ierr, herr)
```

```
     h = h * factor
! converte de J/mol para kJ/kg
     HEntComp(i) = h

c    HEntCond

     T = TSaiComp(i)
     P = PSaiComp(i)

     call TPFLSH (T, P, X, D, Dl, Dv, xl, yv, q, e, h,
sSaiComp, cv, cp, w, ierr, herr)

     h = h * factor
! converte de J/mol para kJ/kg
     HEntCond(i) = h

c     HSaiCond
c
c    si la temperatura de salida del condensador es
mayor o igual que la temperatura de saturación a la
presión de salida del condensador (error de termopar)
entonces hay que aplicar alguna medida para obtener una
entalpía apropiada a los cálculos. Esto va a introducir
un error que será avisado por una variable de error
(erro(i)=Y/N ).
c

     T = TSaiCond(i)
     P = PSaiCond(i)

     call satp (P, x, kph, tscond, rhol, rhov, xl, yv,
ierr, herr)

     if (t.ge.tscond) then

     erroent(i) = 'Y'

call therm(tscond, rhol, x, p, e, h, s, cv, cp, x, hjt)

          else
     erroent(i) = 'N'

call TPFLSH (T, P, X, D, Dl, Dv, xl, yv, q, e, h, s,
cv, cp, w, ierr, herr)

     endif

      h = h * factor
! converte de J/mol para kJ/kg
           HSaiCond(i) = h

c     HEntEvap

     HEntEvap(i) = HSaiCond(i)

!  Puede aproximarse la eficiencia isentrópica del
DispExp?
```

```
c    cálculo de la entalpia correspondiente a la
descarga del compresor para compresión isentrópica

c    para obter propriedades de (2s) (i.e., compressão
isentrópica). 'Tenta-se' até encontrar a temperatura
correspondente à compressão isoentrópica

     pcond = PSaiComp(i)

     kph = 2
     x(1) = 1.d0

     call satp (pcond, x, kph, tcond, rhol, rhov, xliq,
yvap, ierr, herr)

     tmin = tcond
     tmax = TSaiComp(i)

     t2s = ( tmin + tmax ) / 2.0d0
     s1 = SEntComp
     s2s = SEntComp + 1000.0d0
     ilcont = 0

     do while (dabs(s2s-s1).gt.0.1d0)

     call TPFLSH (t2s, pcond, z, d, dl, dv, xl, yv,
tit2s, e, h2s, s2s, cv, cp, w, ierr, herr)

     ilcont = ilcont + 1

     if (s2s.lt.s1) then
     tmin = t2s
     t2s = ( t2s + tmax ) / 2.0d0
     else if (s2s.gt.s1) then
     tmax = t2s
     t2s = ( tmin + t2s ) / 2.0d0
     else
     t2s = t2s
     end if

     h2s = h2s * factor
     HCompIst(i) = h2s

     if (ilcont.eq.2000) then
     s2s = s1
     HCompIst(i) = 99999.9999
     endif

          enddo

c    el problema está en encontrar donde está
trabajando el compressor!

     enddo

     return
```

```
end
c*******************************************************
subroutine   DTcal   (TEntComp,   PEntEvap,   PEntComp,
TSaiCond, PSaiComp, PSaiCond, dTsaq, dTsbr)

c          subroutina para el cálculo del grado de
sobrecalentamiento y del grado de subresfriamiento
c
c*******************************************************
c    MSc. Frank C. Pruzaesky
c    Pontifícia Universidade Católica do Rio de Janeiro
c    Depto de Engenharia Mecânica
c    Laboratório de Refrigeração e Aquecimento
c*******************************************************

implicit double precision (a-h,o-z)
implicit integer (i-n)

parameter (ncmax=5)  !dimension for compositions, etc.
character*3 hrf      !reference state specification
character*255 herr   !error string output by routines

dimension  x(ncmax),  z(ncmax),xkg(ncmax),  xl(ncmax),
yv(ncmax)

Dimension TEntComp(210), PEntEvap(210), PEntComp(210),
TSaiCond(210), PSaiComp(210), PSaiCond(210), Tsaq(210),
dTsbr(210)

     x(1) = 1.0d0
     z(1) = 1.0d0

     do i = 1, 205

c         cálculo del grado de sobrecalentamiento

     pEvap = PEntComp(i)

     call satp (pEvap, x, kph, tEvap, rhol, rhov, xliq,
yvap, ierr, herr)

     dTsaq(i) = TEntComp(i) - tEvap

c         cálculo del grado de subresfriamiento

     pCond = PSaiCond(i)

     call satp (pCond, x, kph, tCond, rhol, rhov, xliq,
yvap, ierr, herr)

     dTsbr(i) = tCond - TSaiCond(i)

          enddo

      Return

      End
```

```
c*******************************************************

     subroutine   Resultados   (HEntComp,   HEntCond,
HSaiCond, HEntEvap, HCompIst, dTsaq, dTsbr, erroent)

c*******************************************************
c    MSc. Frank C. Pruzaesky
c    Pontifícia Universidade Católica do Rio de Janeiro
c    Depto de Engenharia Mecânica
c    Laboratório de Refrigeração e Aquecimento
c*******************************************************
      implicit double precision (a-h,o-z)
      implicit integer (i-n)

     character*15 ArqSalida
     character*48 PathdelFile
     character*1 erroent

dimension HEntComp(210), HEntCond(210), HSaiCond(210),
HEntEvap(210), HCompIst(210), dTsaq(210), dTsbr(210),
erroent(210)

     PathdelFile       =       'C:\Documents       and
Settings\guest\Meus documentos\'
     ArqSalida = 'MyOtherText.txt'

     OPEN(2 , FILE= PathdelFile // ArqSalida, STATUS =
'unknown')

     do i = 1, 205
          write (2,*) HEntComp(i)
          write (2,*) HEntCond(i)
          write (2,*) HSaiCond(i)
          write (2,*) HEntEvap(i)
          write (2,*) HCompIst(i)
          write (2,*) dTsaq(i)
          write (2,*) dTsbr(i)
          write (2,*) erroent(i)
     enddo

     close (2)

     return
     end

*******************************************************
```

Apêndice A 2 – Dados reduzidos dos testes da bomba de calor

teste	T_cond *°C*	P_cond *PSI*	T_evap *°C*	P_evap *PSI*	DT saq *°C*	DT subr *°C*
1	45,0	236,3	6,3	73,6	14,9	1,6
2		236,3	5,1	70,4	13,0	1,5
3	40,0	208,5	3,0	65,0	10,4	1,2
4		207,8	5,0	70,2	13,9	1,2
4'		207,8	5,0	70,2	13,9	1,2
4''		208,3	4,7	69,5	13,6	1,4
6	37,0	190,4	5,0	70,2	14,8	0,8
7		190,2	3,6	66,5	12,2	0,8
9	36,0	184,2	3,0	65,1	11,2	0,6
10		181,9	0,7	59,4	7,4	0,8
I	39,5	207,3	0,7	59,5	5,4	6,0
II		207,6	4,2	68,1	11,8	6,3
III		207,6	6,2	73,5	15,0	6,6
IV		208,6	6,4	74,0	15,0	6,4
V	35,5	188,1	6,7	74,9	17,0	4,8
VI		188,3	4,0	67,6	11,7	4,7
VII		187,8	0,9	59,9	6,2	4,8
VIII	33,5	177,7	0,5	58,8	6,1	4,0
IX		179,5	1,5	61,3	7,5	4,1

teste	m_w_evap *kg / s*	T_e_w_evap *°C*	T_s_w_evap *°C*	Q_evap *W*
1	0,118	25,2	15,0	5041
2	0,080	26,5	12,9	4610
3	0,080	23,6	9,9	4459
4	0,114	23,2	12,9	4919
4'	0,116	22,9	12,8	4917
4''	0,116	22,9	12,8	4933
6	0,118	23,9	13,4	5230
7	0,082	24,9	10,3	4987
9	0,080	24,1	10,0	4685
10	0,063	24,3	8,4	3941
I	0,081	21,2	11,2	3307
II	0,241	17,6	13,6	4302
III	0,336	21,2	18,0	4887
IV	0,183	24,3	18,2	4834
V	0,311	24,0	20,4	5038
VI	0,111	23,8	14,5	4366
VII	0,066	24,8	10,3	3841
VIII	0,066	25,1	9,6	4083
IX	0,075	24,9	11,6	4021

teste	m_w_cond *kg / s*	T_e_w_cond *°C*	T_s_w_cond *°C*	Q_cond *W*
1	0,212	28,3	36,1	6876
2	0,206	28,4	36,1	6615
3	0,283	26,7	32,2	6423
4	0,310	27,2	32,3	6607
4'	0,297	26,9	32,2	6590
4''	0,297	26,9	32,2	6590
6	0,531	27,0	30,1	7089
7	0,487	27,1	30,4	6607
9	0,530	26,4	29,2	6390
10	0,488	26,4	29,1	5683
I	0,307	27,5	32,7	6684
II	0,385	27,5	32,2	7573
III	0,432	27,2	31,8	8308
IV	0,432	27,3	31,9	8307
V	0,830	26,9	29,6	9675
VI	0,648	26,8	29,8	8367
VII	0,523	26,7	30,0	7421
VIII	0,822	26,5	28,9	8529
IX	0,814	26,6	29,0	8444

teste	W_comp *W*	m_ref *kg / s*	D_x_Comp *kW*	D_x_Evap *kW*	D_x_Cond *kW*
1	2264	0,0300	1,126	0,302	0,486
2	2264	0,0282	1,162	0,298	0,459
3	2128	0,0275	1,164	0,273	0,383
4	2156	0,0286	1,180	0,278	0,400
4'	2156	0,0285	1,167	0,278	0,409
4''	2156	0,0285	1,163	0,280	0,409
6	2048	0,0298	1,126	0,301	0,363
7	2077	0,0285	1,165	0,294	0,341
9	1940	0,0271	1,090	0,280	0,318
10	1940	0,0245	1,131	0,280	0,282
I	2174	0,0239	1,284	0,267	0,331
II	2149	0,0272	1,164	0,251	0,395
III	2181	0,0297	1,152	0,312	0,440
IV	2304	0,0304	1,296	0,337	0,428
V	2187	0,0327	1,206	0,380	0,406
VI	2191	0,0296	1,263	0,331	0,356
VII	2150	0,0271	1,264	0,321	0,313
VIII	2088	0,0301	1,183	0,346	0,305
IX	2142	0,0294	1,246	0,346	0,310

teste	D_x_TXV *kW*	D_x_Total *kW*	q_evap *kJ / kg*	T_cd - T_ev *°C*	P_cd / P_ev
1	0,118	2,031	163,9	38,7	3,2
2	0,119	2,038	161,9	39,9	3,4
3	0,096	1,915	165,2	37,1	3,2
4	0,091	1,949	168,8	35,0	3,0
4'	0,092	1,945	168,8	35,0	3,0
4''	0,093	1,945	168,5	35,3	3,0
6	0,077	1,867	173,5	31,7	2,7
7	0,081	1,882	171,0	33,1	2,9
9	0,075	1,762	171,3	32,4	2,8
10	0,076	1,768	168,3	34,3	3,1
I	0,076	1,959	167,3	39,1	3,5
II	0,073	1,883	173,7	35,7	3,0
III	0,069	1,973	177,4	33,7	2,8
IV	0,069	2,130	177,1	33,7	2,8
V	0,060	2,051	181,9	29,5	2,5
VI	0,065	2,015	176,5	32,3	2,8
VII	0,070	1,968	171,3	35,2	3,1
VIII	0,071	1,904	172,7	33,7	3,0
IX	0,067	1,969	173,9	33,0	2,9

teste	W_cp / m_ref *kJ / kg*	eta_isent	C O P ref	C O P aqc	eta_II
1	75,53	0,45	2,17	3,04	0,21
2	80,38	0,45	2,01	2,92	0,20
3	77,40	0,43	2,13	3,02	0,18
4	75,48	0,43	2,24	3,06	0,17
4'	75,72	0,43	2,23	3,06	0,19
4''	75,68	0,43	2,23	3,06	0,20
6	68,65	0,41	2,53	3,46	0,20
7	72,92	0,42	2,34	3,18	0,23
9	71,54	0,41	2,40	3,29	0,21
10	79,30	0,41	2,12	2,93	0,23
I	91,07	0,42	1,84	3,07	0,26
II	78,90	0,43	2,20	3,52	0,29
III	73,33	0,43	2,42	3,81	0,38
IV	75,87	0,43	2,33	3,61	0,36
V	66,83	0,41	2,72	4,42	0,42
VI	74,13	0,41	2,38	3,82	0,33
VII	79,21	0,41	2,16	3,45	0,28
VIII	69,34	0,40	2,49	4,08	0,31
IX	72,75	0,40	2,39	3,94	0,35

Apêndice A 3 – Dados reduzidos dos testes do sitema de trigeração com substituição de óleo Diesel

P_ele_GE; kW	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5
alfa_GNV	0,00	0,25	0,31	0,41	0,45	0,53	0,53	0,61	0,63	0,69
m_w_EV; L / min	0,2	0,2	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
T_e_w_EV; °C	22,1	19,6	20,2	19,7	20,2	19,7	20,1	19,9	20,1	20,0
T_s_w_EV; °C	13,0	12,0	12,5	11,9	12,4	12,0	12,4	12,2	12,3	12,3
P_evap; PSI	59,5	56,5	56,8	56,5	56,8	56,4	56,8	56,6	56,8	56,7
T_evap; °C	0,5	-0,8	-0,7	-0,8	-0,7	-0,8	-0,7	-0,8	-0,7	-0,7
¬T_saq; °C	10,2	8,0	8,4	8,0	8,4	8,1	8,3	8,2	8,3	8,2
Q_evap; kW	4,467	3,714	3,767	3,794	3,784	3,757	3,791	3,782	3,801	3,764
m_w_CD; L / min	35,0	34,5	34,5	34,5	34,5	34,5	34,5	34,5	34,5	34,5
T_e_w_CD; °C	25,5	26,4	26,7	26,4	26,7	26,4	26,7	26,6	26,7	26,6
T_s_w_CD; °C	28,7	29,6	29,9	29,6	29,9	29,6	29,9	29,7	29,8	29,8
P_cond; PSI	182,2	186,3	188,3	186,5	188,3	186,8	188,3	187,3	188,1	187,8
T_cond; °C	25,5	26,3	26,5	26,3	26,5	26,3	26,6	26,4	26,5	26,4
¬T_sbr; °C	4,8	4,8	4,9	4,8	4,9	4,8	4,8	4,8	4,9	4,9
Q_cond; kW	7,885	7,697	7,597	7,637	7,630	7,611	7,601	7,659	7,645	7,727
V_CP; V	221,6	221,8	220,5	221,9	221,3	221,9	221,6	221,7	221,7	222,0
I_CP; A	10,5	10,4	10,4	10,4	10,4	10,4	10,4	10,4	10,4	10,5
P_ele_CP; kW	2,094	2,076	2,064	2,077	2,071	2,077	2,074	2,075	2,075	2,098
m_ref; kg / s	0,02907	0,02672	0,02671	0,02683	0,02683	0,02668	0,02679	0,02687	0,02691	0,02696
COP ref	2,70	2,53	2,56	2,53	2,55	2,53	2,55	2,54	2,54	2,54
COP aquec	3,77	3,71	3,68	3,68	3,68	3,66	3,66	3,69	3,68	3,68
eta_s_CP; %	40,2	39,9	40,5	39,9	40,5	39,9	40,5	40,6	40,5	40,6
m_w_EG; L / min	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0
T_e_w_EG; °C	28,5	29,4	29,8	29,5	29,8	29,5	29,8	29,7	29,8	29,7
T_s_w_EG; °C	41,2	42,0	43,0	42,4	42,7	42,3	42,8	42,3	42,7	42,5
Q_EG; kW	4,364	4,320	4,516	4,458	4,431	4,400	4,455	4,339	4,452	4,411

m_w_EC; *L / min*	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0
T_e_w_EC; *°C*	41,2	42,0	43,0	42,4	42,7	42,3	42,8	42,3	42,7	42,5
T_s_w_EC; *°C*	53,5	55,5	56,6	55,9	57,0	56,3	57,3	57,1	57,7	57,7
Q_EC; *kW*	5,092	5,580	5,631	5,590	5,942	5,794	5,997	6,133	6,188	6,276
m_Diesel; *kg / s*	0,000371	0,000285	0,000289	0,000265	0,000260	0,000240	0,000246	0,000225	0,000223	0,000205
m_GNV; *kg / s*	0,000000	0,000084	0,000110	0,000159	0,000188	0,000235	0,000241	0,000307	0,000328	0,000406
m_ar; *kg / s*	0,0255	0,0255	0,0254	0,0254	0,0254	0,0254	0,0254	0,0254	0,0254	0,0252
Excesso_ar; *kg / kg_f*	32,814	53,969	48,625	44,524	41,294	37,701	36,483	31,788	30,164	25,271
% Diesel_subst	0,00	25,11	24,31	30,95	32,00	36,93	35,71	41,00	41,79	46,40
Q_fuel; *kW*	15,757	16,218	17,629	18,987	20,207	21,672	22,181	24,551	25,459	28,506
V_GE; *V*	223,0	223,1	222,2	223,4	222,8	223,6	223,0	223,1	223,7	223,4
I_GE; *A*	15,5	15,6	15,7	15,8	15,7	15,6	15,7	15,7	15,7	15,7
P_ele_GE; *kW*	3,457	3,480	3,489	3,530	3,498	3,488	3,501	3,503	3,512	3,507
T_amb; *°C*	25,9	26,9	27,2	26,9	27,2	26,8	27,2	27,1	27,2	27,2
T_w_evap; *°C*	9,1	7,6	7,7	7,8	7,7	7,7	7,7	7,7	7,8	7,7
T_w_rec; *°C*	28,0	29,1	29,8	29,5	30,3	29,9	30,5	30,5	31,0	31,1
E_P_dem; *kW*	1,362	1,404	1,425	1,453	1,427	1,411	1,427	1,428	1,437	1,409
CONDENSADOR										
T_med_w_CD; *°C*	27,1	28,0	28,3	28,0	28,3	28,0	28,3	28,1	28,3	28,2
E_e_w_CD; *kW*	-0,115	-0,145	-0,129	-0,132	-0,147	-0,109	-0,131	-0,149	-0,153	-0,185
E_s_w_CD; *kW*	0,848	0,766	0,759	0,773	0,743	0,795	0,757	0,750	0,739	0,715
E_w_CD; *kJ / kg*	0,963	0,911	0,888	0,905	0,889	0,904	0,888	0,899	0,892	0,900
Q_rec_CD; *kW*	1,341	1,328	1,311	1,318	1,316	1,313	1,312	1,322	1,319	1,333
MOTOR										
T_med_w_EG; *°C*	34,9	35,7	36,4	35,9	36,2	35,9	36,3	36,0	36,2	36,1
E_e_w_EG; *kW*	0,794	0,721	0,745	0,740	0,722	0,769	0,739	0,728	0,718	0,687
E_s_w_EG; *kW*	4,587	4,312	4,449	4,447	4,347	4,438	4,391	4,301	4,362	4,294
E_w_EG; *kW*	3,793	3,591	3,704	3,707	3,625	3,670	3,652	3,573	3,644	3,607

ECONOMIZADOR										
T_med_w_EC; °C	47,4	48,7	49,8	49,2	49,9	49,3	50,0	49,7	50,2	50,1
E_e_w_EC; kW	4,587	4,312	4,449	4,447	4,347	4,438	4,391	4,301	4,362	4,294
E_s_w_EC; kW	8,257	8,156	8,278	8,301	8,378	8,445	8,467	8,488	8,562	8,549
\E_w_EC; kW	3,669	3,844	3,829	3,854	4,031	4,006	4,077	4,187	4,200	4,255
EVAPORADOR										
T_med_w_evap; °C	17,6	15,8	16,3	15,8	16,3	15,9	16,3	16,1	16,2	16,1
E_e_w_evap; kW	-1,124	-2,072	-1,972	-2,052	-1,988	-2,033	-1,983	-2,021	-2,004	-2,042
E_s_w_evap; kW	-3,832	-4,238	-4,140	-4,267	-4,161	-4,232	-4,165	-4,207	-4,188	-4,202
\E_w_evap; kW	2,708	2,166	2,168	2,215	2,173	2,199	2,182	2,186	2,184	2,160
E_fuel; kW	15,757	16,218	17,629	18,987	20,207	21,672	22,181	24,551	25,459	28,506
%_Cumulativo										
Q_fuel	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
P_dem	0,09	0,09	0,08	0,08	0,07	0,07	0,06	0,06	0,06	0,05
Q_CD	0,77	0,78	0,73	0,68	0,65	0,60	0,59	0,54	0,53	0,47
Q_EG	0,36	0,35	0,34	0,31	0,29	0,27	0,27	0,23	0,23	0,20
Q_EC	0,69	0,70	0,66	0,61	0,58	0,54	0,54	0,48	0,47	0,42
Q_evap	1,06	1,01	0,94	0,87	0,84	0,77	0,77	0,69	0,68	0,60
soma	1,06	1,01	0,94	0,87	0,84	0,77	0,77	0,69	0,68	0,60
ECR	0,97	0,93	0,87	0,81	0,77	0,71	0,71	0,64	0,62	0,56
eta_II	0,16	0,15	0,14	0,13	0,13	0,12	0,11	0,10	0,10	0,09

P_ele_GE; kW	4,8	4,5	4,5	4,5	4,5	4,5	4,5	4,5
alfa_GNV	0,00	0,26	0,36	0,46	0,50	0,58	0,63	0,69
m_w_EV; L / min	0,2	0,2	0,2	0,2	0,2	0,1	0,1	0,1
T_e_w_EV; °C	22,2	20,2	20,2	20,2	20,3	20,2	20,2	20,2
T_s_w_EV; °C	13,1	12,6	12,6	12,6	12,7	12,6	12,5	12,6
P_evap; PSI	59,6	57,3	57,3	57,2	57,1	57,1	57,1	57,1
T_evap; °C	0,6	-0,4	-0,4	-0,4	-0,5	-0,5	-0,5	-0,5
(T_saq; °C	10,2	8,8	8,8	8,8	8,7	8,8	8,8	8,7
Q_evap; kW	4,475	3,732	3,738	3,714	3,733	3,736	3,782	3,732
m_w_CD; L / min	35,0	34,5	34,5	34,5	34,5	34,5	34,5	34,5
T_e_w_CD; °C	25,5	27,0	27,0	27,0	27,0	27,0	27,0	27,0
T_s_w_CD; °C	28,8	30,1	30,1	30,2	30,1	30,1	30,1	30,1
P_cond; PSI	182,6	190,0	190,2	190,3	190,2	190,3	190,4	190,4
T_cond; °C	25,5	26,8	26,9	26,9	26,8	26,8	26,8	26,8
(T_sbr; °C	4,8	4,9	4,9	4,9	4,9	4,9	4,9	4,9
Q_cond; kW	7,923	7,561	7,565	7,573	7,273	7,468	7,295	7,344
V_CP; V	219,6	221,0	221,5	222,0	222,0	222,3	222,6	222,9
I_CP; A	10,4	10,4	10,4	10,4	10,5	10,5	10,6	10,6
P_ele_CP; kW	2,055	2,069	2,073	2,078	2,098	2,101	2,124	2,126
m_ref; kg / s	0,02918	0,02655	0,02658	0,02652	0,02597	0,02637	0,02614	0,02610
COP ref	2,70	2,56	2,55	2,55	2,56	2,55	2,54	2,55
COP aquec	3,85	3,66	3,65	3,64	3,47	3,55	3,44	3,45
eta_s_CP; %	40,1	41,0	41,0	41,0	41,1	41,0	41,0	41,1
m_w_EG; L / min	6,0	6,1	6,1	6,1	6,1	6,1	6,1	6,1
T_e_w_EG; °C	28,6	30,1	30,1	30,1	30,1	30,1	30,1	30,1
T_s_w_EG; °C	43,0	43,3	43,2	43,5	43,1	43,5	43,2	43,3
Q_EG; kW	4,946	4,628	4,604	4,692	4,547	4,693	4,562	4,608

m_w_EC; *L / min*	6,0	6,1	6,1	6,1	6,1	6,1	6,1	6,1
T_e_w_EC; *°C*	43,0	43,3	43,2	43,5	43,1	43,5	43,2	43,3
T_s_w_EC; *°C*	57,8	58,3	58,5	58,9	58,5	59,2	59,4	59,7
Q_EC; *kW*	6,158	6,322	6,441	6,483	6,473	6,620	6,842	6,912
m_Diesel; *kg / s*	0,000317	0,000292	0,000265	0,000269	0,000248	0,000236	0,000218	0,000514
m_GNV; *kg / s*	0,000095	0,000141	0,000198	0,000238	0,000304	0,000354	0,000423	0,000000
m_ar; *kg / s*	0,0255	0,0254	0,0254	0,0254	0,0254	0,0253	0,0252	0,0254
Excesso_ar; *kg / kg_f*	25,920	46,877	43,473	39,207	34,386	30,185	26,995	23,368
% Diesel_subst	0,00	27,12	32,88	39,27	38,55	43,63	46,38	50,43
Q_fuel; *kW*	19,311	18,082	19,275	20,944	23,056	25,348	27,287	29,871
V_GE; *V*	221,3	222,6	223,1	223,5	223,5	224,0	224,4	224,4
I_GE; *A*	21,8	20,0	20,0	20,1	20,2	20,3	20,2	20,2
P_ele_GE; *kW*	4,824	4,452	4,462	4,492	4,515	4,547	4,533	4,533
T_amb; *°C*	26,4	27,3	27,4	27,4	27,0	27,1	27,1	27,0
T_w_evap; *°C*	9,1	7,6	7,6	7,5	7,6	7,6	7,7	7,6
T_w_rec; *°C*	32,3	31,3	31,5	31,9	31,4	32,2	32,4	32,7
E_P_dem; *kW*	2,769	2,383	2,389	2,414	2,417	2,446	2,409	2,406
CONDENSADOR								
T_med_w_CD; *°C*	27,1	28,6	28,6	28,6	28,5	28,6	28,5	28,5
E_e_w_CD; *kW*	-0,263	-0,083	-0,120	-0,103	0,000	-0,021	-0,022	0,006
E_s_w_CD; *kW*	0,681	0,796	0,753	0,774	0,856	0,855	0,833	0,872
E_w_CD; *kJ / kg*	0,945	0,879	0,873	0,876	0,855	0,876	0,855	0,865
Q_rec_CD; *kW*	1,348	1,326	1,327	1,328	1,276	1,310	1,280	1,288
MOTOR								
T_med_w_EG; *°C*	35,8	36,7	36,7	36,8	36,6	36,8	36,6	36,7
E_e_w_EG; *kW*	0,632	0,780	0,736	0,759	0,866	0,843	0,848	0,882
E_s_w_EG; *kW*	4,829	4,489	4,401	4,503	4,553	4,639	4,534	4,625
E_w_EG; *kW*	4,197	3,709	3,664	3,744	3,687	3,796	3,687	3,742

ECONOMIZADOR								
T_med_w_EC; °C	50,4	50,8	50,9	51,2	50,8	51,4	51,3	51,5
E_s_w_EC; kW	4,829	4,489	4,401	4,503	4,553	4,639	4,534	4,625
E_s_w_EC; kW	9,163	8,696	8,658	8,798	8,910	9,086	9,126	9,286
\E_w_EC; kW	4,335	4,207	4,257	4,295	4,358	4,447	4,591	4,661
EVAPORADOR								
T_med_w_evap; °C	17,6	16,4	16,4	16,4	16,5	16,4	16,4	16,4
E_s_w_evap; kW	-1,239	-1,999	-2,026	-2,012	-1,922	-1,951	-1,949	-1,927
E_s_w_evap; kW	-3,888	-4,119	-4,136	-4,114	-4,069	-4,094	-4,116	-4,077
\E_w_evap; kW	2,649	2,120	2,110	2,101	2,146	2,143	2,168	2,149
E_fuel; kW	19,311	18,082	19,275	20,944	23,056	25,348	27,287	29,871
%_Cumulativo								
Q_fuel	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
P_dem	0,14	0,13	0,12	0,12	0,10	0,10	0,09	0,08
Q_CD	0,79	0,81	0,77	0,71	0,64	0,59	0,55	0,51
Q_EG	0,40	0,39	0,36	0,34	0,30	0,28	0,26	0,23
Q_EC	0,72	0,74	0,70	0,65	0,58	0,54	0,51	0,47
Q_evap	1,02	1,02	0,96	0,89	0,80	0,74	0,69	0,63
soma	1,02	1,02	0,96	0,89	0,80	0,74	0,69	0,63
ECR	0,95	0,94	0,89	0,83	0,74	0,69	0,64	0,59
eta_II	0,21	0,19	0,18	0,17	0,15	0,14	0,13	0,12

P_ele_GE; kW	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6
alfa_GNV	0,00	0,11	0,23	0,33	0,40	0,45	0,51	0,59	0,65
m_w_EV; L / min	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
T_e_w_EV; °C	22,2	19,8	19,9	20,0	20,0	19,9	20,0	20,0	20,0
T_s_w_EV; °C	13,0	12,0	12,0	12,0	12,2	12,0	12,2	12,2	12,0
P_evap; PSI	59,3	57,1	57,2	57,2	57,3	56,9	57,2	57,2	57,1
T_evap; °C	0,5	-0,5	-0,5	-0,5	-0,4	-0,6	-0,5	-0,5	-0,6
¬T_saq; °C	10,3	8,2	8,3	8,3	8,3	8,3	8,3	8,3	8,3
Q_evap; kW	4,515	3,846	3,900	3,912	3,846	3,844	3,810	3,803	3,850
m_w_CD; L / min	35,0	30,5	30,5	30,5	30,5	30,5	30,5	30,5	30,5
T_e_w_CD; °C	25,6	27,5	27,6	27,7	27,7	27,6	27,7	27,7	27,7
T_s_w_CD; °C	28,8	31,2	31,3	31,3	31,4	31,3	31,3	31,3	31,3
P_cond; PSI	183,2	193,9	194,3	194,7	194,9	194,7	195,0	195,0	194,9
T_cond; °C	25,6	27,5	27,5	27,6	27,6	27,5	27,6	27,6	27,5
¬T_sbr; °C	4,8	4,9	4,9	5,0	5,0	5,0	5,0	5,0	5,0
Q_cond; kW	7,924	7,803	7,832	7,793	7,789	7,790	7,802	7,781	7,795
V_CP; V	220,3	221,3	221,2	221,3	221,3	221,1	220,9	221,1	221,1
I_CP; A	10,5	10,5	10,5	10,4	10,4	10,4	10,5	10,4	10,4
P_ele_CP; kW	2,082	2,091	2,090	2,071	2,071	2,069	2,088	2,069	2,069
m_ref; kg / s	0,02928	0,02747	0,02770	0,02766	0,02746	0,02746	0,02739	0,02732	0,02749
COP ref	2,69	2,48	2,49	2,49	2,49	2,49	2,49	2,49	2,49
COP aquec	3,81	3,73	3,75	3,76	3,76	3,76	3,74	3,76	3,77
eta_s_CP; %	40,1	40,8	40,7	40,7	40,7	40,8	40,7	40,7	40,8
m_w_EG; L / min	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0
T_e_w_EG; °C	28,7	30,9	31,0	31,1	31,1	31,1	31,1	31,1	31,1
T_s_w_EG; °C	44,5	45,7	45,9	46,2	46,4	46,2	46,1	46,1	46,0
Q_EG; kW	5,439	5,068	5,094	5,181	5,243	5,204	5,144	5,142	5,113

m_w_EC; *L / min*	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0
T_e_w_EC; *°C*	44,5	45,7	45,9	46,2	46,4	46,2	46,1	46,1	46,0
T_s_w_EC; *°C*	61,4	63,3	63,4	64,2	64,5	63,6	64,1	64,6	64,5
Q_EC; *kW*	7,006	7,273	7,245	7,441	7,511	7,191	7,432	7,638	7,639
m_Diesel; *kg / s*	0,000398	0,000369	0,000343	0,000325	0,000318	0,000300	0,000276	0,000254	0,000662
m_GNV; *kg / s*	0,000042	0,000097	0,000145	0,000191	0,000225	0,000277	0,000348	0,000411	0,000000
m_ar; *kg / s*	0,0252	0,0252	0,0252	0,0252	0,0252	0,0252	0,0251	0,0251	0,0252
Excesso_ar; *kg / kg_f*	21,662	42,679	39,182	36,410	33,536	30,995	28,086	24,523	21,861
% Diesel_subst	0,00	22,86	28,17	33,08	36,70	38,25	41,63	46,36	50,57
Q_fuel; *kW*	21,836	18,948	20,411	21,648	23,081	24,442	26,221	28,656	30,818
V_GE; *V*	222,0	223,1	222,9	222,9	222,9	223,0	222,6	222,7	223,0
I_GE; *A*	25,4	25,2	25,1	25,0	25,0	25,1	25,1	25,1	25,1
P_ele_GE; *kW*	5,639	5,622	5,595	5,573	5,573	5,597	5,587	5,590	5,597
T_amb; *°C*	26,6	29,2	29,1	29,2	29,3	28,6	29,1	29,1	28,8
¬T_w_evap; *°C*	9,2	7,8	7,9	7,9	7,8	7,9	7,8	7,8	7,9
¬T_w_rec; *°C*	35,9	35,7	35,8	36,5	36,8	36,0	36,4	36,9	36,8
E_P_dem; *kW*	3,557	3,531	3,504	3,501	3,501	3,528	3,500	3,520	3,528
CONDENSADOR									
T_med_w_CD; *°C*	27,2	29,4	29,4	29,5	29,5	29,4	29,5	29,5	29,5
E_e_w_CD; *kW*	-0,302	-0,429	-0,386	-0,388	-0,397	-0,265	-0,365	-0,350	-0,294
E_s_w_CD; *kW*	0,634	0,502	0,555	0,545	0,531	0,694	0,572	0,586	0,657
¬E_w_CD; *kJ / kg*	0,936	0,932	0,941	0,933	0,928	0,959	0,937	0,937	0,951
Q_rec_CD; *kW*	1,348	1,519	1,525	1,517	1,516	1,516	1,519	1,515	1,517
MOTOR									
T_med_w_EG; *°C*	36,6	38,3	38,4	38,6	38,8	38,7	38,6	38,6	38,6
E_e_w_EG; *kW*	0,599	0,436	0,490	0,490	0,474	0,646	0,521	0,534	0,605
E_s_w_EG; *kW*	5,173	4,200	4,298	4,350	4,360	4,629	4,363	4,386	4,486
¬E_w_EG; *kW*	4,574	3,764	3,807	3,860	3,886	3,984	3,843	3,852	3,881

ECONOMIZADOR									
T_med_w_EC; °C	53,0	54,5	54,6	55,2	55,5	54,9	55,1	55,3	55,2
E_e_w_EC; *kW*	5,173	4,200	4,298	4,350	4,360	4,629	4,363	4,386	4,486
E_s_w_EC; *kW*	10,063	8,681	8,789	8,949	8,978	9,196	8,969	9,131	9,296
¬E_w_EC; *kW*	4,889	4,481	4,492	4,598	4,619	4,567	4,606	4,746	4,810
EVAPORADOR									
T_med_w_evap; °C	17,6	15,9	15,9	16,0	16,1	16,0	16,1	16,1	16,0
E_e_w_evap; *kW*	-1,273	-2,402	-2,366	-2,353	-2,351	-2,290	-2,329	-2,328	-2,302
E_s_w_evap; *kW*	-3,920	-4,390	-4,395	-4,383	-4,336	-4,370	-4,342	-4,342	-4,368
¬E_w_evap; *kW*	2,648	1,988	2,029	2,029	1,985	2,081	2,013	2,014	2,066
E_fuel; *kW*	21,836	18,948	20,411	21,648	23,081	24,442	26,221	28,656	30,818
%_Cumulativo									
Q_fuel	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
P_dem	0,16	0,19	0,17	0,16	0,15	0,14	0,13	0,12	0,11
Q_CD	0,79	0,92	0,85	0,81	0,77	0,71	0,67	0,62	0,58
Q_EG	0,41	0,45	0,42	0,40	0,38	0,36	0,33	0,30	0,28
Q_EC	0,73	0,84	0,78	0,74	0,70	0,65	0,61	0,57	0,53
Q_evap	1,00	1,12	1,04	1,00	0,94	0,87	0,82	0,75	0,70
soma	1,00	1,12	1,04	1,00	0,94	0,87	0,82	0,75	0,70
E C R	0,94	1,04	0,97	0,93	0,87	0,81	0,76	0,70	0,65
eta_II	0,22	0,25	0,23	0,22	0,20	0,19	0,18	0,16	0,15

P_ele_GE; kW	7,2	7,3	7,4	7,5	7,5	7,5	7,5	7,5	7,5
alfa_GNV	0,00	0,17	0,26	0,34	0,37	0,44	0,48	0,52	0,57
m_w_EV; L / min	0,2	0,3	0,3	0,3	0,2	0,2	0,2	0,2	0,2
T_e_w_EV; °C	22,4	19,0	19,0	19,0	19,2	19,2	19,3	19,3	19,2
T_s_w_EV; °C	13,2	11,5	11,6	11,6	11,8	11,8	11,8	11,8	11,7
P_evap; PSI	59,7	56,0	55,9	56,0	56,1	56,0	56,1	56,0	55,9
T_evap; °C	0,6	-1,0	-1,1	-1,1	-1,0	-1,0	-1,0	-1,0	-1,1
¬T_saq; °C	10,4	8,1	8,1	8,1	7,9	7,9	8,0	7,9	7,9
Q_evap; kW	4,518	3,678	3,647	3,661	3,587	3,575	3,612	3,626	3,642
m_w_CD; L / min	35,0	30,8	30,8	30,8	30,8	30,8	30,8	30,8	30,8
T_e_w_CD; °C	25,7	27,0	27,0	27,0	27,1	27,1	27,1	27,1	27,1
T_s_w_CD; °C	28,9	30,4	30,4	30,4	30,5	30,5	30,6	30,6	30,5
P_cond; PSI	183,4	190,5	190,6	190,9	191,3	191,3	191,4	191,4	191,3
T_cond; °C	25,8	26,9	26,8	26,8	27,0	27,0	27,0	27,1	26,9
¬T_sbr; °C	4,8	4,9	4,9	5,0	4,9	4,9	4,9	4,9	5,0
Q_cond; kW	7,890	7,333	7,398	7,457	7,407	7,393	7,415	7,347	7,338
V_CP; V	209,1	211,8	212,4	212,5	212,8	213,4	213,3	213,9	213,9
I_CP; A	9,7	10,1	9,9	9,9	9,7	9,9	10,0	10,0	10,0
P_ele_CP; kW	1,825	1,925	1,892	1,893	1,858	1,901	1,920	1,925	1,925
m_ref; kg / s	0,02932	0,02602	0,02606	0,02623	0,02594	0,02587	0,02603	0,02593	0,02595
COP ref	2,75	2,54	2,54	2,54	2,53	2,53	2,53	2,53	2,53
COP aquec	4,32	3,81	3,91	3,94	3,99	3,89	3,86	3,82	3,81
eta_s_CP; %	40,9	41,7	41,7	41,7	41,1	41,8	41,1	41,1	41,2
m_w_EG; L / min	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0
T_e_w_EG; °C	28,8	30,4	30,4	30,4	30,5	30,5	30,6	30,6	30,5
T_s_w_EG; °C	47,0	49,4	49,3	49,6	48,7	48,5	48,7	48,6	48,1
Q_EG; kW	6,255	6,549	6,513	6,585	6,226	6,161	6,214	6,177	6,027

m_w_EC; *L / min*	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0
T_e_w_EC; *°C*	47,0	49,4	49,3	49,6	48,7	48,5	48,7	48,6	48,1
T_s_w_EC; *°C*	69,8	73,0	72,7	74,5	71,5	71,5	71,9	71,8	71,3
Q_EC; *kW*	9,424	9,742	9,676	10,295	9,441	9,509	9,623	9,603	9,632
m_Diesel; *kg / s*	0,000507	0,000473	0,000441	0,000446	0,000414	0,000401	0,000384	0,000354	0,000000
m_GNV; *kg / s*	0,000090	0,000144	0,000194	0,000231	0,000280	0,000324	0,000363	0,000410	0,000000
m_ar; *kg / s*	0,0250	0,0249	0,0250	0,0250	0,0249	0,0249	0,0250	0,0250	0,0000
Excesso_ar; *kg / kg_f*	15,478	27,074	25,484	24,196	21,704	20,500	18,813	17,844	17,005
%Diesel_subst	0,00	24,57	29,81	35,61	35,48	39,91	41,94	44,46	48,88
Q_fuel; *kW*	28,101	25,914	27,059	28,182	30,171	31,255	32,816	34,022	35,014
V_GE; *V*	211,3	213,6	214,1	214,4	214,6	214,9	215,2	215,5	215,5
I_GE; *A*	34,3	34,4	34,4	34,9	35,1	35,0	35,0	35,0	35,0
P_ele_GE; *kW*	7,248	7,348	7,365	7,483	7,532	7,522	7,532	7,543	7,543
T_amb; *°C*	27,6	27,3	27,8	27,7	29,9	29,8	30,2	30,0	29,9
¬T_w_evap; *°C*	9,2	7,5	7,4	7,4	7,4	7,4	7,4	7,5	7,5
¬T_w_rec; *°C*	44,1	46,0	45,8	47,5	44,4	44,4	44,8	44,6	44,3
E_P_dem; *kW*	5,422	5,423	5,473	5,589	5,675	5,620	5,612	5,617	5,617
CONDENSADOR									
T_med_w_CD; *°C*	27,3	28,7	28,7	28,7	28,8	28,8	28,9	28,8	28,8
E_e_w_CD; *kW*	-0,543	-0,085	-0,233	-0,186	-0,679	-0,658	-0,746	-0,700	-0,699
E_s_w_CD; *kW*	0,348	0,867	0,705	0,766	0,169	0,193	0,087	0,134	0,138
¬E_w_CD; *kJ / kg*	0,890	0,952	0,938	0,952	0,848	0,851	0,832	0,834	0,836
Q_rec_CD; *kW*	1,342	1,414	1,426	1,438	1,428	1,425	1,430	1,416	1,415
MOTOR									
T_med_w_EG; *°C*	37,9	39,9	39,8	40,0	39,6	39,5	39,6	39,6	39,3
E_e_w_EG; *kW*	0,325	0,854	0,700	0,764	0,170	0,195	0,086	0,137	0,144
E_s_w_EG; *kW*	5,348	6,194	5,887	6,047	4,647	4,649	4,467	4,543	4,459
¬E_w_EG; *kW*	5,024	5,340	5,187	5,283	4,476	4,453	4,381	4,406	4,315

ECONOMIZADOR									
T_med_w_EC; °C	58,4	61,2	61,0	62,0	60,1	60,0	60,3	60,2	59,7
E_e_w_EC; kW	5,348	6,194	5,887	6,047	4,647	4,649	4,467	4,543	4,459
E_s_w_EC; kW	11,631	12,789	12,285	12,903	10,281	10,353	10,100	10,228	10,182
–E_w_EC; kW	6,283	6,596	6,398	6,857	5,634	5,704	5,632	5,685	5,723
EVAPORADOR									
T_med_w_evap; °C	17,8	15,3	15,3	15,3	15,5	15,5	15,5	15,5	15,4
E_e_w_evap; kW	-1,453	-2,329	-2,417	-2,371	-2,630	-2,622	-2,655	-2,629	-2,640
E_s_w_evap; kW	-3,984	-4,416	-4,438	-4,415	-4,453	-4,449	-4,456	-4,458	-4,483
–E_w_evap; kW	2,531	2,088	2,022	2,045	1,823	1,827	1,801	1,829	1,843
E_fuel; kW	28,101	25,914	27,059	28,182	30,171	31,255	32,816	34,022	35,014
%_Cumulativo									
Q_fuel	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
P_dem	0,19	0,21	0,20	0,20	0,19	0,18	0,17	0,17	0,16
Q_CD	0,80	0,89	0,85	0,85	0,75	0,73	0,70	0,67	0,65
Q_EG	0,42	0,46	0,44	0,43	0,39	0,38	0,36	0,35	0,33
Q_EC	0,75	0,84	0,80	0,80	0,71	0,68	0,65	0,63	0,61
Q_evap	0,96	1,03	0,99	0,98	0,87	0,84	0,81	0,78	0,75
soma	0,96	1,03	0,99	0,98	0,87	0,84	0,81	0,78	0,75
ECR	0,91	0,98	0,94	0,93	0,83	0,80	0,76	0,74	0,71
eta_II	0,25	0,27	0,26	0,25	0,23	0,22	0,21	0,20	0,20

Apêndice A 4 – Dados reduzidos dos testes de otimização exergética

m_w_EG; *L / min*	0				3			
m_w_EV; *L / min*		4,0	7,0	15,0	0,0	5,0	7,0	15,0
T_e_w_EV; °C		25,1	22,5	17,1	0,0	21,1	19,8	18,1
T_s_w_EV; °C		11,5	13,5	13,0	0,0	9,8	11,3	14,0
P_evap; *PSI*		53,8	60,4	62,0	0,0	57,0	60,3	63,1
T_evap; *°C*		-2,5	0,9	1,6	0,0	-0,6	0,9	2,1
□T_saq; *°C*		6,3	10,5	12,7	0,0	8,4	11,0	13,4
Q_evap; *kW*		3,586	4,432	4,461	0,000	3,838	4,222	4,517
m_w_CD; *L / min*	35,0	35,0	35,0	35,0	35,0	35,0	34,8	34,5
T_e_w_CD; °C	26,5	26,5	26,3	24,7	25,0	25,0	24,8	24,6
T_s_w_CD; °C	29,1	29,1	29,3	27,8	28,1	28,1	28,0	28,0
P_cond; *PSI*	0,0	182,4	186,9	182,0	0,0	178,8	180,5	182,5
T_cond; *°C*	0,0	26,4	26,4	24,0	0,0	25,1	24,9	23,9
□T_sbr; *°C*	0,0	4,4	4,8	5,5	0,0	4,6	4,9	5,6
Q_cond; *kW*	6,6	6,550	7,242	7,411	7,722	7,722	7,920	8,130
V_CP; *V*	0,0	211,4	211,1	211,5	0,0	210,5	209,9	209,6
I_CP; *A*	0,0	10,4	10,3	10,2	0,0	10,0	10,1	10,4
P_ele_CP; *kW*	0,0	1,979	1,957	1,942	0,000	1,895	1,908	1,962
m_ref; *kg / s*	0,0000	0,0242	0,0278	0,0278	0,0000	0,0271	0,0284	0,0294
COP ref	0,00	2,54	2,75	2,90	0,00	2,71	2,83	2,93
COP aquec	0,00	3,31	3,70	3,82	0,00	4,08	4,15	4,14
eta_s_CP; *%*	0,00	0,41	0,42	0,41	0,00	0,40	0,41	0,40
m_w_EG; *L / min*	0,0	0,0	0,0	0,0	3,0	3,0	3,0	3,0
T_e_w_EG; °C	29,2	29,2	29,4	27,9	28,0	28,0	28,0	27,9
T_s_w_EG; *°C*	49,8	49,8	40,4	32,5	53,6	53,6	54,0	54,2
Q_EG; *kW*	0,000	0,000	0,000	0,000	4,015	4,015	4,080	4,128
m_w_EC; *L / min*	4,5	4,5	8,0	17,0	3,0	3,0	3,0	3,0
T_e_w_EC; °C	49,8	49,8	40,4	32,5	53,6	53,6	54,0	54,2
T_s_w_EC; *°C*	71,9	71,9	52,6	38,1	94,5	94,5	82,6	83,9
Q_EC; *kW*	0,000	0,000	0,000	0,000	8,453	8,453	5,906	6,125
m_fuel; kg / s	0,00052	0,00052	0,00053	0,00052	0,00048	0,00048	0,00049	0,00048
m_ar; *kg / s*	0,02519	0,02519	0,02519	0,02519	0,02525	0,02525	0,02519	0,02519
Q_fuel; *kW*	22,10000	22,11809	22,32821	21,93161	20,47690	20,47690	20,72254	20,46507
V_GE; *V*	213,3	213,3	213,0	213,4	0,0	212,0	212,0	211,5
I_GE; *A*	26,1	26,1	26,2	26,2	0,0	26,4	26,7	26,3
P_ele_GE; *kW*	5,567	5,567	5,581	5,591	5,597	5,597	5,660	5,562
T_amb; *°C*	27,7	27,7	27,3	25,5	24,4	24,4	24,8	24,6

m_w_EG; *L / min*	0				3			
□T_w_evap; °*C*	0,0	13,6	9,0	4,0	0,0	11,3	8,6	4,1
□T_w_rec; °*C*	45,5	45,5	26,3	13,3	69,5	69,5	57,8	59,3
E_P_dem; *kW*	5,567	3,588	3,624	3,650	5,597	3,702	3,752	3,601
CONDENSADOR								
T_med_w_CD; °*C*	27,8	27,8	27,8	26,3	26,6	26,6	26,4	26,3
E_e_w_CD; *kW*	-0,332	-0,332	-0,286	-0,233	0,194	0,194	-0,006	-0,012
E_s_w_CD; *kW*	0,406	0,406	0,542	0,686	1,198	1,198	1,011	1,049
□E_w_CD; *kJ / kg*	0,000	0,000	0,000	0,000	1,004	1,004	1,017	1,061
Q_rec_CD; *kW*	0,000	0,000	0,000	0,000	0,657	0,657	0,678	0,701
MOTOR								
T_med_w_EG; °*C*	39,5	39,5	34,9	30,2	40,8	40,8	41,0	41,1
E_e_w_EG; *kW*	0,430	0,430	0,582	0,732	1,148	1,148	0,984	1,032
E_s_w_EG; *kW*	6,094	6,094	3,661	2,122	9,293	9,293	9,116	9,317
□E_w_EG; *kW*	0,000	0,000	0,000	0,000	8,145	8,145	8,131	8,286
ECONOMIZADOR								
T_med_w_EC; °*C*	60,9	60,9	46,5	35,3	74,0	74,0	68,3	69,1
E_e_w_EC; *kW*	6,094	6,094	3,661	2,122	9,293	9,293	9,116	9,317
E_s_w_EC; *kW*	12,184	12,184	7,063	3,815	22,293	22,293	18,049	18,648
□E_w_EC; *kW*	0,000	0,000	0,000	0,000	13,000	13,000	8,933	9,331
EVAPORADOR								
T_med_w_evap; °*C*	0,0	18,3	18,0	15,0	0,0	15,5	15,5	16,1
E_e_w_evap; *kW*	-7,616	-0,700	-1,356	-2,566	-7,753	-1,037	-1,559	-2,042
E_s_w_evap; *kW*	-7,616	-4,438	-3,871	-3,792	-7,753	-4,620	-4,235	-3,331
□E_w_evap; *kW*	0,000	3,738	2,516	1,226	0,000	3,583	2,675	1,289
E_fuel; *kW*	22,100	22,118	22,328	21,932	20,477	20,477	20,723	20,465
%_Cumulativo								
Q_fuel	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
P_dem	0,25	0,16	0,16	0,17	0,27	0,18	0,18	0,18
Q_CD	0,25	0,16	0,16	0,17	0,31	0,21	0,21	0,21
Q_EG	0,25	0,16	0,16	0,17	0,50	0,41	0,41	0,41
Q_EC	0,25	0,16	0,16	0,17	0,91	0,82	0,70	0,71
Q_evap	0,25	0,32	0,36	0,37	0,91	1,01	0,90	0,93
soma	0,25	0,32	0,36	0,37	0,91	1,01	0,90	0,93
E C R	0,25	0,32	0,36	0,37	0,88	0,98	0,87	0,90
eta_II	0,25	0,17	0,17	0,17	0,35	0,20	0,19	0,18

m_w_EG; *L / min*	4				8			
m_w_EV; *L / min*	0,0	4,0	7,0	15,0	0,0	4,0	7,0	15,0
T_e_w_EV; °C	0,0	25,1	23,4	21,9	0,0	24,4	22,5	21,1
T_s_w_EV; °C	0,0	11,5	14,5	17,5	0,0	11,0	13,5	16,8
P_evap; *PSI*	0,0	53,8	61,6	66,2	0,0	53,2	60,4	65,3
T_evap; *°C*	0,0	-2,5	1,4	3,3	0,0	-2,7	0,9	2,9
□T_saq; *°C*	0,0	6,3	10,8	14,5	0,0	6,1	10,5	14,1
Q_evap; *kW*	0,000	3,586	4,398	4,836	0,000	3,520	4,432	4,772
m_w_CD; *L / min*	35,0	35,0	35,0	35,0	35,0	35,0	35,0	35,0
T_e_w_CD; °C	26,5	26,5	26,5	26,5	26,3	26,3	26,3	26,4
T_s_w_CD; °C	29,1	29,1	29,5	29,6	29,0	29,0	29,3	29,5
P_cond; *PSI*	0,0	182,4	187,8	191,3	0,0	182,6	186,9	190,5
T_cond; *°C*	0,0	26,4	26,7	26,3	0,0	26,1	26,4	26,2
□T_sbr; *°C*	0,0	4,4	4,7	5,3	0,0	4,5	4,8	5,2
Q_cond; *kW*	6,550	6,550	7,227	7,701	6,604	6,604	7,242	7,656
V_CP; *V*	0,0	211,4	211,1	210,9	0,0	211,6	211,1	210,6
I_CP; *A*	0,0	10,4	10,5	10,7	0,0	10,1	10,3	10,5
P_ele_CP; *kW*	0,000	1,979	1,995	2,031	0,000	1,923	1,957	1,990
m_ref; *kg / s*	0,00000	0,02417	0,02767	0,02956	0,00000	0,02410	0,02782	0,02934
COP ref	0,00	2,54	2,75	2,88	0,00	2,54	2,75	2,88
COP aquec	0,00	3,31	3,62	3,79	0,00	3,43	3,70	3,85
eta_s_CP; *%*	0,00	0,41	0,41	0,41	0,00	0,41	0,42	0,42
m_w_EG; *L / min*	4,5	4,5	4,5	4,5	8,0	8,0	8,0	8,0
T_e_w_EG; °C	29,2	29,2	29,6	29,8	29,2	29,2	29,4	29,7
T_s_w_EG; *°C*	49,8	49,8	50,1	50,6	40,2	40,2	40,4	40,7
Q_EG; *kW*	5,147	5,147	5,137	5,206	5,178	5,178	5,155	5,147
m_w_EC; *L / min*	4,5	4,5	4,5	4,5	8,0	8,0	8,0	8,0
T_e_w_EC; °C	49,8	49,8	50,1	50,6	40,2	40,2	40,4	40,7
T_s_w_EC; *°C*	71,9	71,9	72,7	73,0	52,2	52,2	52,6	53,0
Q_EC; *kW*	6,861	6,861	6,996	6,944	6,595	6,595	6,725	6,801
m_fuel; kg / s	0,00052	0,00052	0,00053	0,00053	0,00052	0,00052	0,00053	0,00053
m_ar; *kg / s*	0,02519	0,02519	0,02519	0,02519	0,02519	0,02519	0,02519	0,02519
Q_fuel; *kW*	22,10000	22,11809	22,33133	22,57372	22,24086	22,24086	22,32821	22,52290
V_GE; *V*	0,0	213,3	212,9	212,7	0,0	213,5	213,0	212,5
I_GE; *A*	0,0	26,1	26,5	26,5	0,0	26,3	26,2	26,3
P_ele_GE; *kW*	5,567	5,567	5,642	5,637	5,615	5,615	5,581	5,589
T_amb; *°C*	27,7	27,7	27,7	27,6	27,3	27,3	27,3	27,4

m_w_EG; *L / min*	4				8			
□T_w_evap; °*C*	0,0	13,6	8,9	4,4	0,0	13,3	9,0	4,3
□T_w_rec; °*C*	45,5	45,5	46,2	46,5	25,8	25,8	26,3	26,6
E_P_dem; *kW*	5,567	3,588	3,647	3,606	5,615	3,692	3,624	3,599
CONDENSADOR								
T_med_w_CD; °*C*	27,8	27,8	28,0	28,1	27,7	27,7	27,8	28,0
E_e_w_CD; *kW*	-0,332	-0,332	-0,320	-0,300	-0,260	-0,260	-0,286	-0,267
E_s_w_CD; *kW*	0,406	0,406	0,493	0,571	0,497	0,497	0,542	0,607
□E_w_CD; *kJ / kg*	0,737	0,737	0,813	0,871	0,757	0,757	0,828	0,875
Q_rec_CD; *kW*	0,836	0,836	0,922	0,983	1,498	1,498	1,643	1,737
MOTOR								
T_med_w_EG; °*C*	39,5	39,5	39,9	40,2	34,7	34,7	34,9	35,2
E_e_w_EG; *kW*	0,430	0,430	0,531	0,610	0,530	0,530	0,582	0,642
E_s_w_EG; *kW*	6,094	6,094	6,184	6,366	3,632	3,632	3,661	3,713
□E_w_EG; *kW*	5,664	5,664	5,653	5,756	3,103	3,103	3,079	3,072
ECONOMIZADOR								
T_med_w_EC; °*C*	60,9	60,9	61,4	61,8	46,2	46,2	46,5	46,8
E_e_w_EC; *kW*	6,094	6,094	6,184	6,366	3,632	3,632	3,661	3,713
E_s_w_EC; *kW*	12,184	12,184	12,392	12,559	6,979	6,979	7,063	7,151
□E_w_EC; *kW*	6,090	6,090	6,209	6,193	3,347	3,347	3,402	3,438
EVAPORADOR								
T_med_w_evap; °*C*	0,0	18,3	18,9	19,7	0,0	17,7	18,0	19,0
E_e_w_evap; *kW*	-7,616	-0,700	-1,178	-1,576	-7,648	-0,812	-1,356	-1,737
E_s_w_evap; *kW*	-7,616	-4,438	-3,636	-2,791	-7,648	-4,549	-3,871	-2,947
□E_w_evap; *kW*	0,000	3,738	2,458	1,214	0,000	3,737	2,516	1,210
E_fuel; *kW*	22,100	22,118	22,331	22,574	22,241	22,241	22,328	22,523
%_Cumulativo								
Q_fuel	1,0	1,0	1,0	1,0	0,0	1,0	1,0	1,0
P_dem	0,25	0,16	0,16	0,16	0,25	0,17	0,16	0,16
Q_CD	0,29	0,20	0,20	0,20	0,32	0,23	0,24	0,24
Q_EG	0,52	0,43	0,43	0,43	0,55	0,47	0,47	0,47
Q_EC	0,83	0,74	0,75	0,74	0,85	0,76	0,77	0,77
Q_evap	0,83	0,91	0,94	0,96	0,85	0,92	0,97	0,98
soma	0,83	0,91	0,94	0,96	0,85	0,92	0,97	0,98
E C R	0,80	0,87	0,90	0,91	0,78	0,85	0,89	0,90
eta_II	0,29	0,22	0,21	0,21	0,28	0,20	0,19	0,19

m_w_EG; *L / min*	17			
m_w_EV; *L / min*	0,0	5,0	7,0	15,0
T_e_w_EV; °C	0,0	19,4	18,6	17,1
T_s_w_EV; °C	0,0	7,9	10,1	13,0
P_evap; *PSI*	0,0	55,2	58,4	62,0
T_evap; *°C*	0,0	-1,4	0,1	1,6
□T_saq; *°C*	0,0	7,8	9,9	12,7
Q_evap; *kW*	0,000	3,899	4,188	4,461
m_w_CD; *L / min*	35,0	35,0	35,0	35,0
T_e_w_CD; °C	24,7	24,7	24,9	24,7
T_s_w_CD; °C	27,5	27,5	27,8	27,8
P_cond; *PSI*	0,0	177,1	179,6	182,0
T_cond; *°C*	0,0	24,4	24,8	24,0
□T_sbr; *°C*	0,0	4,8	4,9	5,5
Q_cond; *kW*	6,813	6,813	7,123	7,411
V_CP; *V*	0,0	211,8	211,4	211,5
I_CP; *A*	0,0	10,2	10,1	10,2
P_ele_CP; *kW*	0,000	1,944	1,922	1,942
m_ref; *kg / s*	0,00000	0,02538	0,02674	0,02783
COP ref	0,00	2,69	2,78	2,90
COP aquec	0,00	3,50	3,71	3,82
eta_s_CP; *%*	0,00	0,41	0,40	0,41
m_w_EG; *L / min*	17,0	17,0	17,0	17,0
T_e_w_EG; °C	27,6	27,6	27,9	27,9
T_s_w_EG; *°C*	32,3	32,3	32,6	32,5
Q_EG; *kW*	4,823	4,823	4,852	4,716
m_w_EC; *L / min*	17,0	17,0	17,0	17,0
T_e_w_EC; °C	32,3	32,3	32,6	32,5
T_s_w_EC; *°C*	37,6	37,6	38,1	38,1
Q_EC; *kW*	6,180	6,180	6,411	6,570
m_fuel; kg / s	0,00051	0,00051	0,00052	0,00052
m_ar; *kg / s*	0,02519	0,02519	0,02519	0,02519
Q_fuel; *kW*	21,60048	21,60048	21,93908	21,93161
V_GE; *V*	0,0	213,7	213,3	213,4
I_GE; *A*	0,0	26,5	26,4	26,2
P_ele_GE; *kW*	5,663	5,663	5,631	5,591
T_amb; *°C*	25,3	25,3	26,4	25,5

m_w_EG; *L / min*	17			
□T_w_evap; *°C*	0,0	11,4	8,5	4,0
□T_w_rec; *°C*	12,9	12,9	13,2	13,3
E_P_dem; *kW*	5,663	3,719	3,709	3,650
CONDENSADOR				
T_med_w_CD; *°C*	26,1	26,1	26,4	26,3
E_e_w_CD; *kW*	-0,186	-0,186	-0,432	-0,233
E_s_w_CD; *kW*	0,667	0,667	0,418	0,686
□E_w_CD; *kJ / kg*	0,853	0,853	0,850	0,919
Q_rec_CD; *kW*	3,284	3,284	3,434	3,572
MOTOR				
T_med_w_EG; *°C*	30,0	30,0	30,3	30,2
E_e_w_EG; *kW*	0,713	0,713	0,453	0,732
E_s_w_EG; *kW*	2,148	2,148	1,830	2,122
□E_w_EG; *kW*	1,435	1,435	1,377	1,390
ECONOMIZADOR				
T_med_w_EC; *°C*	34,9	34,9	35,4	35,3
E_e_w_EC; *kW*	2,148	2,148	1,830	2,122
E_s_w_EC; *kW*	3,755	3,755	3,420	3,815
□E_w_EC; *kW*	1,607	1,607	1,590	1,693
EVAPORADOR				
T_med_w_evap; *°C*	0,0	13,7	14,3	15,0
E_e_w_evap; *kW*	-7,743	-1,812	-2,279	-2,566
E_s_w_evap; *kW*	-7,743	-5,313	-4,757	-3,792
□E_w_evap; *kW*	0,000	3,502	2,479	1,226
E_fuel; *kW*	21,600	21,600	21,939	21,932
%_Cumulativo				
Q_fuel	0,0	1,0	1,0	1,0
P_dem	0,26	0,17	0,17	0,17
Q_CD	0,41	0,32	0,33	0,33
Q_EG	0,64	0,55	0,55	0,54
Q_EC	0,92	0,83	0,84	0,84
Q_evap	0,92	1,01	1,03	1,05
soma	0,92	1,01	1,03	1,05
E C R	0,77	0,86	0,87	0,88
eta_II	0,28	0,20	0,19	0,18