ENGLISH - THAI MACHINE TRANSLATION

by

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I Introduction

Studies and researches on Machine Translation (M.T.) or Automatised Translation (A.T.) have been conducted since 1949 in the United States and the USSR to translate English into Russian and vice versa. Later on M.T. of other pairs of languages have been carried on both in the USA and Europe. At present many countries in Asia, including Japan, China, Hong Kong, and Malaysia are working on M.T. as well,

Group d'Etudes pour la Traduction Automatique (G.E.T.A.) is the M.T. research group at Universite Scientifique et Medicale de Grenoble, France, under the leadership of Professor B. Vauquois, who has pioneered this undertaking since 1961. While M.T. projects in the USA have been delayed by the conclusion of a report from the Automatic Processing Advisory Committee (ALPAC), which consequently led American researchers to other related topics, e.g. Computational Linguistics, Artificial Intelligence (A.I.), and others,other research groups on M.T. in other countries, especially G.E.T.A., have never given up their effort.

Recently M.T. researches have been back to the main stream again. European Economic Community started to finance EUROTRA for an M.T. project. In Canada TAUM AVIATION project is undertaken at the University of Montreal, for instance.

G.E.T.A. 's translation system is called ARIANE System. The system has been developed for more than 10 years. Since 1978 the system has been tested to translate Russian into French. Other languages have since been tested, including Portuguese, Spanish, Italian, German, English, and Japanese. At present G.E.T.A. is expanding its project in to industrial aspects, especially on English-French and French-English which is much in demand.

In 1980 Professor B. Vauquois introduced this system to Asean countries. The ARIANE System was installed at the Computer Center, Universiti Sains Malaysia, Penang, first. Then researchers in Thailand who are interested in this project have been contacted.

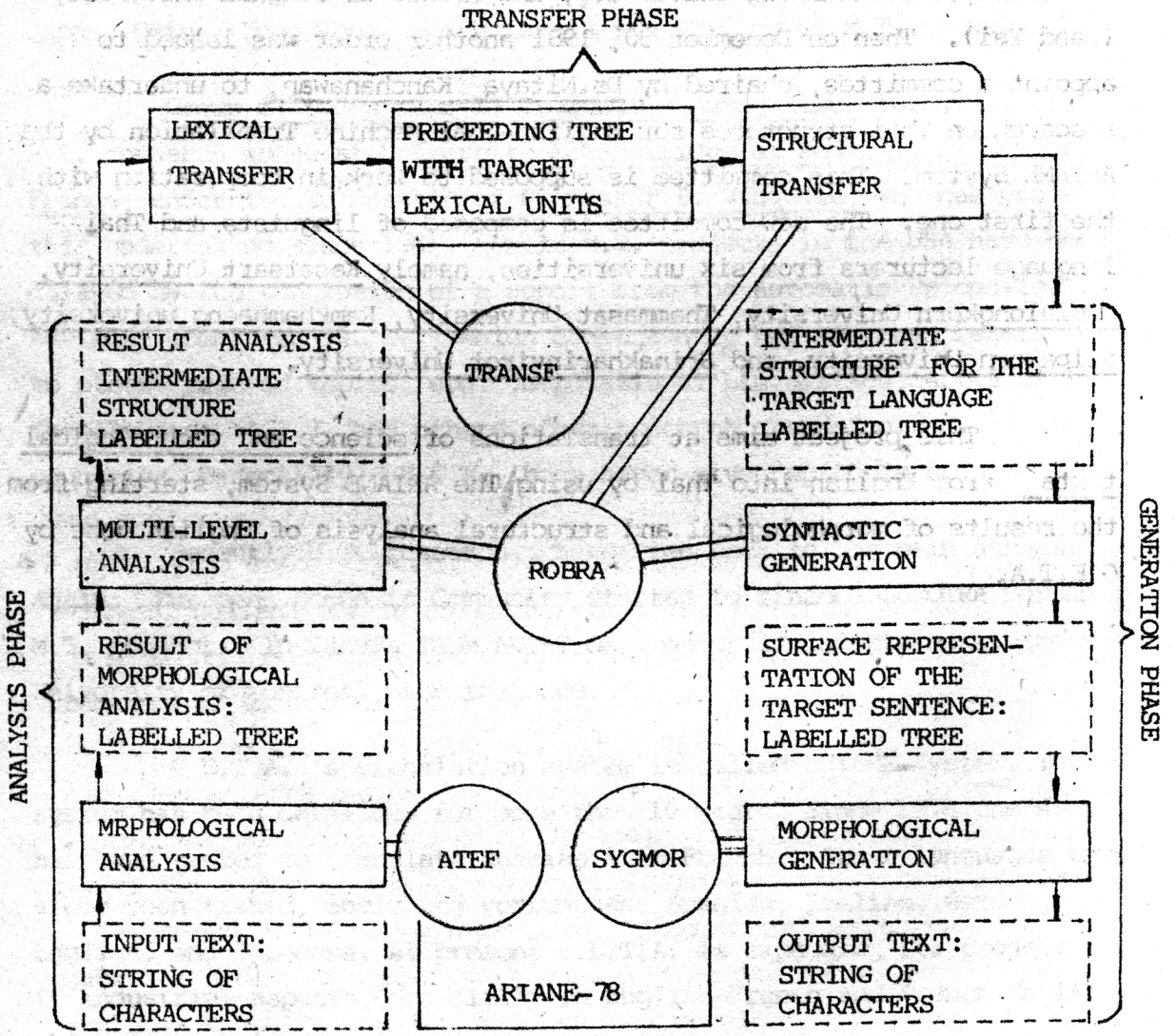
Eventually the Ministry of University Affairs Thailand issued Order No. 23/2524 (1981) dated June 22, 1981 appointing a committee to undertake an English-Thai Machine Translation Project.

This committee, chaired by Professor Udom Warotamasikkhadit, is consisted of officials from three universities, namely Chulalongkorn University, Ramkhamhaeng University, and Prince of Songkla University (Haad Yai). Then on December 30, 1981 another order was issued to appoint a committee, chaired by Dr.Nitaya Kanchanawan, to undertake a research on Thai structures for English-Thai Machine Translation by the ARIANE System. This committee is supposed to work in cooperation with the first one. The new committee is composed of linguists and Thai language lecturers from six universities, namely Kasetsart University, Chulalongkorn University, Thammasat University, Ramkhamhaeng university, Silpakorn University, and Srinakharinvirot University.

This project aims at translations of science and technological texts from English into Thai by using The ARIANE System, starting from the results of morphological and structural analysis of English done by G.E.T.A.

II. The ARIANE System

The present version of the ARIANE System, ARIANE-78, has been running from 1978. The algorithmic components of the system may be illustrated as the following:



The input text is submitted to a morphological analyzer produced by the component: ATEF (string-to-tree transducer). Then, the result is transformed into the multilevel intermediate structure by ROBRA. The transfer phase is divided into two steps: firstly a lexical transfer by TRANSF which is mainly a bilingual dictionary look-up, supplemented with possible solutions for lexical ambiguities; secondly, a structural transfer which is also a tree transduction program coming from ROBRA. Finally, the generation phase begins with the computation of a surface syntactic structure, using ROBRA, and ends with a morphological generation performed by a SYGMOR program which is a tree-to-string transducer. The details of this system may be found in G.E.T.A. (1982), M. Quezel-Ambrunaz (1978), C. Boitet et al (1978), M. Quezel-Ambrunaz (1979), M.Quezel-Ambrunaz (1980), B. Vauquois et al (1982).

III English-Thai MT Model

The English-Thai MT model is consisted of 3 main phases: analysis, transfer, and generation. It has been designed with the purposes of language independence in both analysis and generation phases with language dependence restricted to the transfer phase only. That is during the analysis phase the characteristics of the English language are captured into logico-semantic relationships which are considered universal among languages. Later on they will be adapted or generated back to particular features of Thai. The transfer phase performs the conversion of English lexicals to thier Thai equivalents as well as structural conversions of those peculiar to the source language in which there is no direct equivalent in the target language and thus a different structure is required. This strategy permits not only bilingual translation but multilingual translation by means of changes in the transfer phase only as the analysis and generation phases are separated from each other. Thus analysis and generation models can be written only once for each language.

This model has adopted 3 levels of interpretation of a form: morpho-syntactic classes, syntactic functions, and logico-semantic relations.

The first level describes the properties of each terminal node of the tree structure of a sentence. The properties include terminal morphosyntactic classes (e.g., noun, verb, etc.), grammatical properties (e.g., tense. gender. etc.), derivations (e.g., verb-noun, adj-adv, etc.), syntactic properties (e.g., copula, modal, etc.), semantic properties (e.g., animate, instrument, etc.), and others.

The second level describes the relation between 2 nodes. Information is noted on the source node of that relation. For example, the subject group is bound implicitly to the governing verb of a phrase. Examples of syntactic functions include subject, object, governor, etc.

The third level describes the relationship between the perdicate and its arguments, relationships betwween predicate and term that do not occupy places or arguments (e.g. circumstantials), and relationship between terms that qualify phrases. Examples include aim, qualifier, topic, argument places, etc.

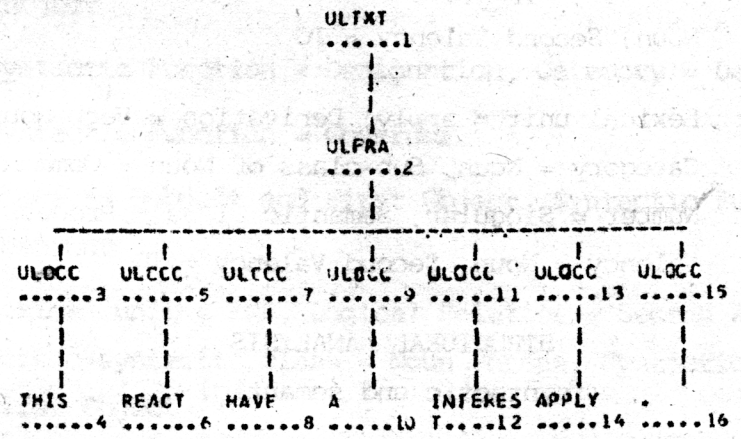
The third level is considered universal among languages. The aim of analysis is to convert a given surface structure to its deep structure or "highest structure" by means of logico-semantic relationships. Consequently, the aim of generation is to obtain a surface structure from this "deep" or "highest" structure.

3.1 English Analysis

Analysis is performed in 2 phases: the morphological phase and the multilevel (syntactic and semantic) phase. The following is an example of an analysis of the sentence:

"THIS REACTION HAS AN INTERESTING APPLICATION."

MORPHOLOGICAL ANALYSIS



THIS: Lexical unit = THIS, Category = Determiner or Representant, Sub-class of Determiner = Demonstrative adjective, Sub-class of Representant = Demonstrative pronoun, Number = Singular

REACTION: Lexical unit = REACT, Derivation = Verb-Noun (action), Category = Noun, Sub-class of Noun = Common Noun, Number = Singular, Semantic Class = Process, First Valency = TO

HAS: Lexical unit = HAVE, Category = Verb, Sub-class of Verb = Conjugated Verb, Number = Singular, Tense = Present, Semantic Class = State, First Valency = Noun or Infinitive Clause

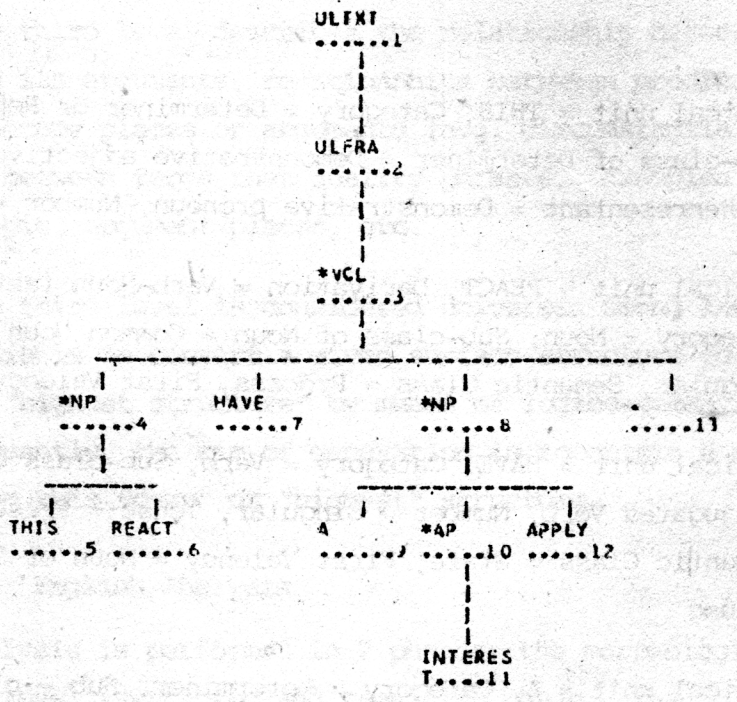
AN: Lexical unit = A, Category = Determiner, Sub - class of Determiner = Indefinite Article, Number = Singular

INTERESTING: Lexical unit = INTERSEST, Category = Verb, Sub-class of Verb = Verb with - ING form, Tense = Present, Verb Ending = Type 1, Semantic Class = State, First Valency = Noun, Second Valency = TO

APPLICATION: Lexical unit = apply, Derivation = Verb-Noun (action), Category = Noun, Sub-class of Noun = Common Noun, Number = Singular, Semantic Class = Process, First Valency = Noun, Second Valency = TO

STRUCTURAL ANALYSIS

(syntactic and semantic)



*VCL: Lexical unit = *VCL, Morpho-syntactic class = Verbal Clause, There is Subject and First Object

*NP(4): Lexical unit = *NP, Logical Relation = First Argument, Morpho-syntactic class = Noun Phrase, Syntactic Function = Subject

THIS: Syntactic Function = Designation, Category = Determiner

REACTION: Syntactic Function = Governor

HAS: There is Subject and First Object, Syntactic Function = Governor

*NP(8): Lexical unit = *NP, Logical Relation = Second Argument, Morpho-syntactic class = Noun Phrase, Syntactic Function = First Object

AN: Syntactic Function = Designation

*AP: Lexical unit = *AP, Semantic Relation = Qualification, Morpho-syntactic class = Ajective Phrase, Syntactic Function = Attribute of a Governor

INTERESTING: Syntactic Function = Governor

APPLICATION: Syntactic Function = Governor

In this example all the properties obtained from the morphological analysis are retained. For reading convenient the same properties are not repeated in the structural analysis except the one changed. In the morphological analysis it is not decided yet whether the category of THIS is a Determiner or a Representant, but in the structural analysis this ambiguity is solved, that is, the category of THIS is a determiner.

3.2 English-Thai Transfer

This phase of translation is dependent upon the 2 languages involved. Transfer is performed in 2 stages: lexical transfer and structural transfer.

3.2.1 Lexical Transfer

This stage has the same function as a bilingual dictionary where a source lexicon is converted to its target lexical item or items. The conversion may be direct, conditional, or ambiguity.

Example of direct conversion is

THIS --- NII

In the case of conditional conversion a source lexicon can be converted to different target equivalents depending on certain criteria, for example:

If INTEREST is a noun --- PHONPRAYOOT
If INTEREST is a verb --- SONCAI

Ambiguity means that certain saurce lexical items will give rise to more than 2 target equivalent which can only be resolved at a later phase.

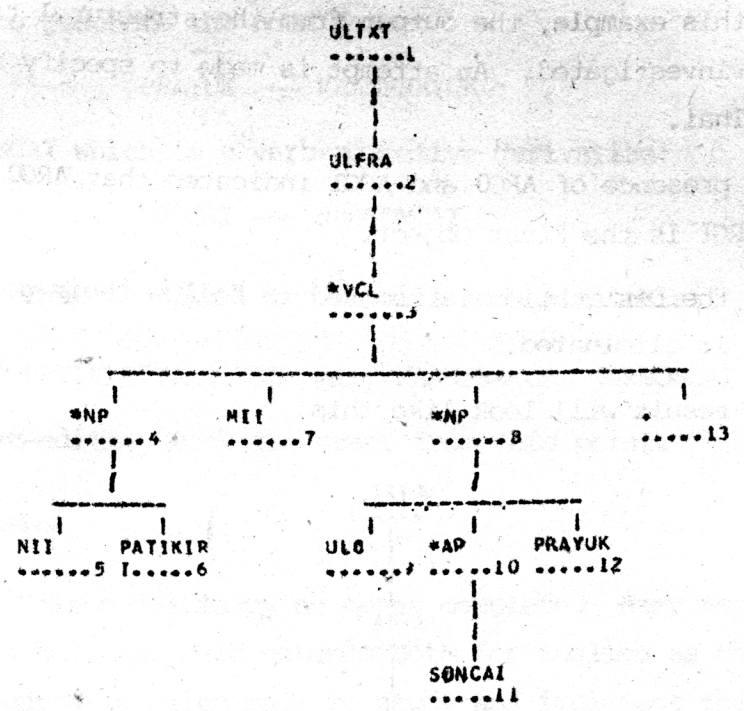
3.2.2 Structural Transfer

In this stage all ambiguities resulting from lexical transfer should be resolved as well as transformations should be incorporated for structures where there is no direct equivalent in the target language.

Certain syntactic functions have no direct equivalents. For example, some postadjectives in English are transformed to relative clauses in Thai.

With the result of the structural analysis serving as the input, the result or output of the transfer phase looks like the following:

STRUCTURAL TRANSFER



In this example output from the lexical transfer stage is not shown. In fact it is the some as output from the structursl transfer stage. Because the output from the lexical transfer stage which serves as the input to the structural transfer stage is unchanged due to the fact that this sentence shares the same structure in both languages. It should be noticed that A in English is transfered to ULO, meaning there is no lexical unit in Thai.

3.3 Thai Generation

At the moment this phase of work is still under way. The expected result may be described as the following:

Thai generation follows a top-down design and involves 2 stages: multilevel generation and morphological generation.

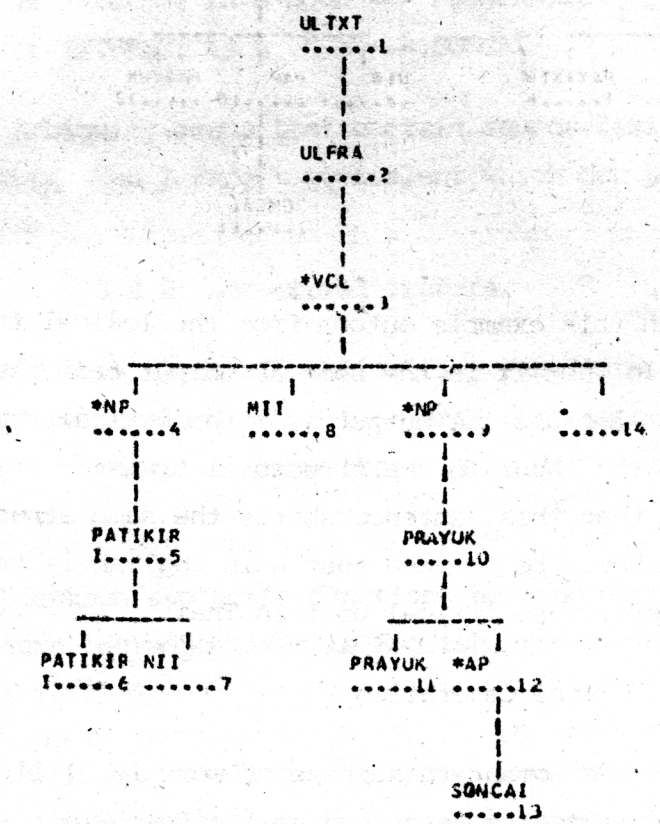
3.3.1 Multilevel Generation

In this example, the output from the structural transfer phase will be investigated. An attempt is made to specify syntactic relations in Thai.

The presence of ARG0 and ARG1 indicates that ARG0 is the Subject and ARG1 is the First Object.

All the Designation is removed to follow their governor. ULO is eliminated.

The result will look like this:



3.3.2 Morphological Generation

Even though Thai is not a reflexive language some morphological generation has to be considered. The correct forms of Thai derivation have to be selected.

In this example,

PRAYUK is a verb-noun derivation, so a rule has to be set to generate the noun form:

PRAYUK --- KAANPRAYUK

so does SONCAI which is a verb-adjective derivation:

SONCAI --- NAASONCAI

Thus the final result will look like this:

PATIKIRIYAA NII MII KAANPRAYUK NAASONCAI

Further post-editing work can start from this point.

IV. Conclusion

This model is by no means complete. Many aspects and types of sentences have not been covered both for English as well as for Thai. Further research is being made to study and implement them.

It can be noticed that the result is in transliterated from. This will be solved in the future version of ARIANE System which will accept different sets of alphabets.

The future work lies havily on the preparation of linguistic data both the grammatical rules and dictionaries. As it can be seen that ARIANE-78 is already there to accept the data, the English-Thai MT Project can be fully successful only when linguistic data is completed. And this will certainly consume an immense amount of time, money and man power. However, it is one of the projects worth an investment.

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B

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***** ENGLISH-THAI MACHINE TRANSLATION PROJECT *****
******* THAILAND ********

MORPHOLOGICAL ANALYSIS

LANGUAGE(S) : EN2

RESULT OF EXECUTION ----- TEXT : CHEM1 6

```
 1: 'ULTXT' 12: 'ULFRA' 13: 'ULOCC' 14: 'THIS'), 5: 'ULOCC' 16: 'REACT'), 7: 'ULOCC' 18: 'HAVE'), 9: 'ULOCC' (
10: 'A'), 11: 'ULOCC' (12: 'INTEREST'), 13: 'ULOCC' (14: 'APPLY'), 15: 'ULOCC' (15: '.')))

1 * *: UL('ULTXT').

   2 * *: UL('ULFRA').

      3 * *: UL('ULOCC').

         4 'THIS': UL('THIS'),STATE(1),CAT(J,R),SUBJ(DEM),SUBR(DEM),NUM(SIN),ANB(1).

      5 * *: UL('ULOCC').

         6 'REACTION': UL('REACT'),DRV(VN),STATE(3),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC),VL1(TO).

      7 * *: UL('ULOCC').

         8 'HAS': UL('HAVE'),STATE(1),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),SEM(STATE),VL1(N,I).

      9 * *: UL('ULOCC').

         10 'AN': UL('A'),STATE(1),CAT(D),SUBD(INDEF),NUM(SIN).

      11 * *: UL('ULOCC').

         12 'INTEREST(ING)': UL('INTEREST'),STATE(3),CAT(V),SUBV(VING),TENSE(PRES),VEN(1),SEM(STATE),VL1(N),
            VL2(TO).

      13 * *: UL('ULOCC').

         14 'APPLICATION': UL('APPLY'),DRV(VN),STATE(3),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC),VL1(N),VL2(T)).

      15 * *: UL('ULOCC').

         16 '.': UL('.'),STATE(1),CAT(P).
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APPENDIX

***** ENGLISH-THAI MACHINE TRANSLATION PROJECT *****
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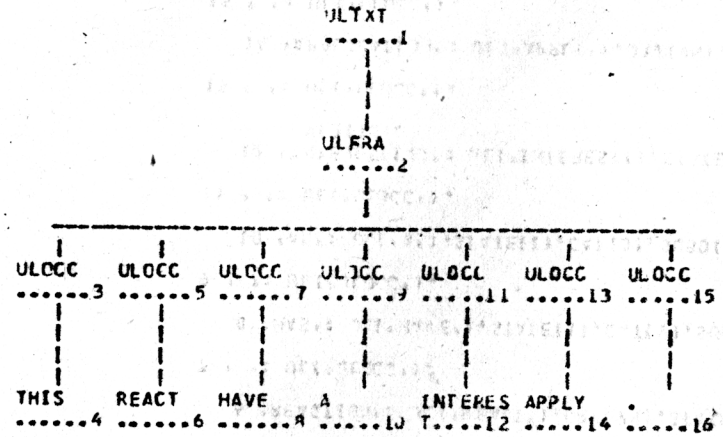
MORPHOLOGICAL ANALYSIS

RESULT OF EXECUTION ----- TEXT : CHEMI .

LANGUAGE(S) : E-T

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NODE 1  ' ': UL('ULTXT').
NODE 2  ' ': UL('ULPRA').
NODE 3  ' ': UL('ULOCC').
NODE 4  'THIS': UL('THIS'),STATE(1),CAT(D,R),SUBD(DEM),SUBR(DEM),NUM(SIN),ART(1).
NODE 5  ' ': UL('ULOCC').
NODE 6  'REACTION': UL('REACT'),DRV(VN),STATE(3),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC),VLL(T).
NODE 7  ' ': UL('ULOCC').
NODE 8  'HAS': UL('HAVE'),STATE(1),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),SEM(STATE),VLL(V,I).
NODE 9  ' ': UL('ULOCC').
NODE 10  'AN': UL('A'),STATE(1),CAT(D),SUBD(INDEF),NUM(SIN).
NODE 11  ' ': UL('ULOCC').
NODE 12  'INTERESTING': UL('INTEREST'),STATE(3),CAT(V),SUBV(VING),TENSE(PRES),VEND(I),SEM(STATE),VLL(I),VL2(TO).
NODE 13  ' ': UL('ULOCC').
NODE 14  'APPLICATION': UL('APPLY'),DRV(VN),STATE(3),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC),VLL(N),VL2(TO).
NODE 15  ' ': UL('ULOCC').
NODE 16  '.': UL('.'),STATE(1),CAT(P).
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***** ENGLISH-THAI MACHINE TRANSLATION PROJECT *****
******* THAILAND ********

STRUCTURAL ANALYSIS

RESULT OF EXECUTION ----- TEXT : CHEMI 5

LANGUAGE(S) : EN2

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 1: 'ULTXT' (2: 'ULFRA' (3: '*VCL' (4: '*NP' (5: 'THIS', 6: 'REACT'), 7: 'HAVE', 8: '*NP' (9: 'A', 10: '*AP' (
11: 'INTEREST'), 12: 'APPLY'), 13: '.')))

1 ' ': UL('ULTXT').

   2 ' ': UL('ULFRA').

      3 ' ': UL('*VCL'),SLOCK(1),LOCK1(1),K(VCL),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),SEM(STATE).

         4 ' ': UL('*NP'),DRV(VN),RL(ARG0),K(NP),SF(SUBJ),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC),VLI(N).

            5 'THIS': UL('THIS'),SF(DES),CAT(D),SUBD(DEM),NUM(SIN).

            6 'REACTION': UL('REACT'),DRV(VN),K(NP),SF(GOV),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC).

         7 'HAS': UL('HAVE'),SLOCK(1),LOCK1(1),K(VCL),SF(GOV),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),SEM(STATE),
           VLI(N).

         8 ' ': UL('*NP'),DRV(VN),RL(ARG1),K(NP),SF(OBJ1),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC),VLI(N).

            9 'A': UL('A'),SF(DES),CAT(D),SUBD(INDEF),NUM(SIN).

            10 ' ': UL('*AP'),RS(QUAL),K(AP),SF(ATS),CAT(V),SUBV(VING),TENSE(PRES),SEM(STATE).

               11 'INTERESTING': UL('INTEREST'),K(AP),SF(GOV),CAT(V),SUBV(VING),TENSE(PRES),SEM(STATE).

            12 'APPLICATION': UL('APPLY'),DRV(VN),K(NP),SF(GOV),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC).

         13 '.': UL('.'),CAT(P).
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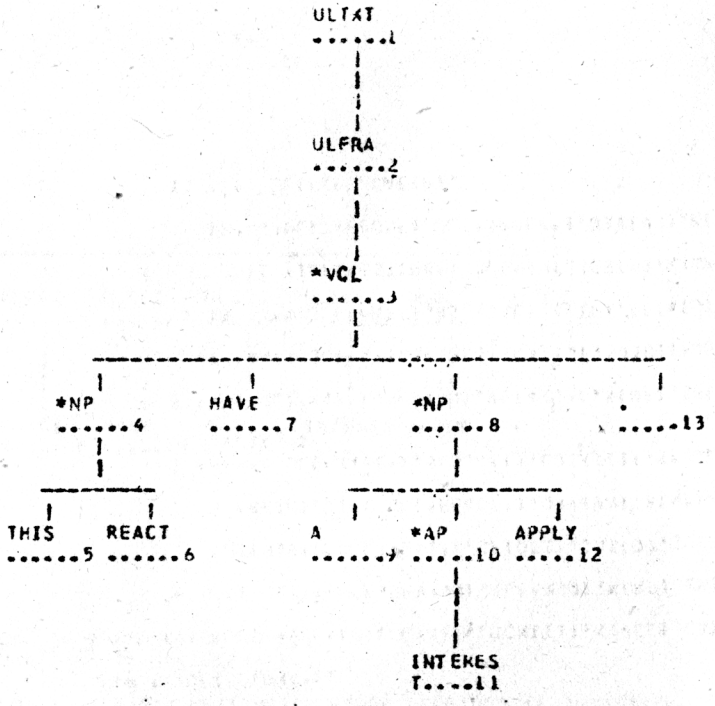
**** ENGLISH-THAI MACHINE TRANSLATION PROJECT ****
******* THAILAND ********

STRUCTURAL ANALYSIS

RESULT OF EXECUTION ---- TEXT : CHEM1 6

LANGUAGE(S) : EN!

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NODE 1  ' ': UL('ULTXT').
NODE 2  ' ': UL('ULFRA').
NODE 3  ' ': UL('*VCL'),SLOCK(1),LOCK1(1),K(VCL),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),SEM(STATE).
NODE 4  ' ': UL('*NP'),DRV(VN),RL(ARG0),K(NP),SF(SUBJ),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC),VL1(N).
NODE 5  'THIS': UL('THIS'),SF(DES),CAT(D),SUBD(DEM),NUM(SIN).
NODE 6  'REACTION': UL('REACT'),DRV(VN),K(NP),SF(GOV),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC).
NODE 7  'HAS': UL('HAVE'),SLOCK(1),LOCK1(1),K(VCL),SF(GOV),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),SEM(STATE),
  VL1(N).
NODE 8  ' ': UL('*NP'),DRV(VN),RL(ARG1),K(NP),SF(OBJ1),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC),VL1(N).
NODE 9  'AN': UL('A'),SF(DES),CAT(D),SUBD(INDEF),NUM(SIN).
NODE 10  ' ': UL('*AP'),RS(QUAL),K(AP),SF(ATS),CAT(V),SUBV(VING),TENSE(PRES),SEM(STATE).
NODE 11  'INTEREST(S)': UL('INTEREST'),K(AP),SF(GOV),CAT(V),SUBV(VING),TENSE(PRES),SEM(STATE).
NODE 12  'APPLICATION': UL('APPLY'),DRV(VN),K(NP),SF(GOV),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC).
NODE 13  '.': UL('.'),CAT(P).
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***** ENGLISH-THAI MACHINE TRANSLATION PROJECT *****
******* THAILAND) ********

LEXICAL TRANSFER

RESULT OF EXECUTION ----- TEXT : CHEMI 6

LANGUAGE(S) : ENG - THI

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 1: 'ULTXT' (2: 'ULFRA' (3: '*VCL' (4: '*NP' (5: 'NII', 6: 'PATIKIRIYAA'), 7: '4II', 8: '*NP' (9: 'JLO',
10: *AP' (11: 'SJNCAI'), 12: 'PRAYUK'), 13: '.')))

1 ' ': UL('ULTXT').

   2 ' ': UL('ULFRA').

      3 ' ': UL('*VCL'),K(VCL),SLOCK(1),LOCKL(1),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),SEM(STATE).

         4 ' ': UL('*NP'),DRV(VN),RL(ARG0),K(NP),SF(SUBJ),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC).

            5 'THIS': UL('NII'),SF(DES),CAT(),R),SUBD(DEM),SUBR(DEM),NUM(SIN).

            6 'REACTION': UL('PATIKIRIYAA'),DRV(VN),K(NP),SF(GOV),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC),TVL1(TO).

         7 'HAS': UL('4II'),K(VCL),SF(GOV),SLOCK(1),LOCKL(1),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),SEM(STATE),
           TVL1(TO).

         8 ' ': UL('*NP'),DRV(VN),RL(ARG1),K(NP),SF(OBJL),CAT(N),SUBN(CN),NUM(SIN),SEM(PROC).

            9 'AN': UL('JLO'),SF(DES),CAT(D),SUBD(INDEF),NUM(SIN).

            10 ' ': UL('*AP'),RS(QUAL),K(AP),SF(ATG),CAT(V),SUBV(VING),TENSE(PRES),SEM(STATE).

               11 'INTERESTING': UL('SJNCAI'),K(AP),SF(GOV),CAT(V),SUBV(VING),TENSE(PRES),SEM(STATE),TVL1(N),
                  TCAUSE(PRED3).

               12 'APPLICATION': UL('PRAYUK'),DRV(VN),K(NP),SF(GOV),CAT(V),SUBN(CN),NUM(SIN),SEM(PROC),TVL1(TO),
                  TVL2(KAP).

         13 '.': UL('.'),CAT(P).
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***** ENGLISH-THAI MACHINE TRANSLATION PROJECT *****
******* THAILAND ********

STRUCTURAL TRANSFER

RESULT OF EXECUTION ----- TEXT : CHEMI 6 LANGUAGE(S) : ENG - THA

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 1: 'ULTXT' (2: 'ULFRA' (3: '*VCL' (4: '*NP' (5: 'NII', 6: 'PATIKIRIYAA'), 7: 'MII', 8: '*NP' (9: 'ULO',
10: '*AP' (11: 'SONGAI'), 12: 'PRAYUK'), 13: '.')))

1 ' ': UL('ULTXT').

  2 ' ': UL('ULFRA').

    3 ' ': UL('*VCL'),K(VCL),SLOCK(1),LOCK1(1),SEM(STATE),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),TTENSE(PRES).

      4 ' ': UL('*NP'),RL(ARG0),K(NP),SF(SUBJ),DRV(VN),TDRV(VA),SEM(PROC),CAT(N),SUBN(CN),NUM(SIN).

        5 'THIS': UL('MII'),SF(DES),CAT(D,R),SUBD(DEM),SUBR(DEM),NUM(SIN).

        6 'REACTION': UL('PATIKIRIYAA'),K(NP),SF(SUBV),DRV(VN),TDRV(VA),SEM(PROC),CAT(N),SUBN(CN),NUM(SIN),
          TVL1(TO).

      7 'HAS': UL('MII'),K(VCL),SF(SUV),SLOCK(1),LOCK1(1),SEM(STATE),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),
        TVL1(TO),TTENSE(PRES).

      8 ' ': UL('*NP'),RL(ARG1),K(NP),SF(OBJ1),DRV(VN),TDRV(VA),SEM(PROC),CAT(N),SUBN(CN),NUM(SIN).

        9 'A': UL('ULO'),SF(DES),CAT(D),SUBD(INDEF),NUM(SIN).

        10 ' ': UL('*AP'),RSTQUAL),K(AP),SF(ATG),TDRV(VA2),SEM(STATE),CAT(V),SUBV(VING),TENSE(PRES),
          TTENSE(PRES).

          11 'INTERESTING': UL('SONGAI'),K(AP),SF(SUV),TDRV(VA2),SEM(STATE),CAT(V),SUBV(VING),
            TENSE(PRES),TVL1(N),TTENSE(PRES).

        12 'APPLICATION': UL('PRAYUK'),K(NP),SF(SUV),DRV(VN),TDRV(VN),SEM(PROC),CAT(V),SUBR(CN),NUM(SIN),
          TVL1(N),TVL2(AP).

      13 '.': UL('.'),CAT(P).
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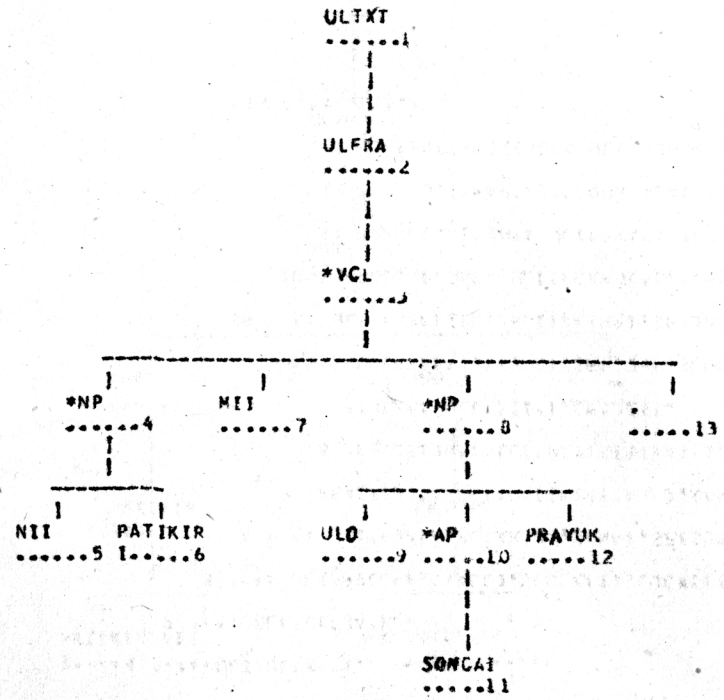
***** ENGLISH-THAI MACHINE TRANSLATION PROJECT *****
******* THAILAND ********

STRUCTURAL TRANSFER

RESULT OF EXECUTION ----- TEXT : CHEMI 6

LANGUAGE(S) : EN2 - THI



NODE 1 ' ': UL('ULTXT').
NODE 2 ' ': UL('ULPRA').
NODE 3 ' ': UL('*VCL'),K(VCL),SLOCK(1),LOCK1(1),SEM(STATE),CAT(V),SUBV(VB),NUM(SIN),TENSE(PRES),TTENSE(PRES).
NODE 4 ' ': UL('*NP'),RL(ARG0),K(NP),SF(SUBJ),DRV(VN),TDRV(V1),SEM(PROG),CAT(N),SUBN(CN),NUM(SIN).
NODE 5 'THIS': UL('NII'),SF(DES),CAT(D,R),SUBD(DEM),SUBR(DEM),NUM(SIN).
NODE 6 'REACTION': UL('PATIKIRIYAA'),K(NP),SF(GOV),DRV(VN),TDRV(V1),SEM(PROG),CAT(N),SUBN(CN),NUM(SIN),TVL1(TO).
NODE 7 'HAS': UL('HII'),K(VCL),SF(GOV),SLOCK(1),LOCK1(1),SEM(STATE),CAT(V),SUBV(V3),NUM(SIN),TENSE(PRES),
TVL1(TO),TTENSE(PRES).
NODE 8 ' ': UL('*NP'),RL(ARG1),K(NP),SF(OBJ1),DRV(VN),TDRV(VN),SEM(PROG),CAT(N),SUBN(CN),NUM(SIN).
NODE 9 'AN': UL('ULO'),SF(DES),CAT(D),SUBD(INDEF),NUM(SIN).
NODE 10 ' ': UL('*AP'),RS(QUAL),K(AP),SF(ATG),TDRV(VA2),SEM(STATE),CAT(V),SUBV(VING),TENSE(PRES),TTENSE(PRES).
NODE 11 'INTERESTING': UL('SONCAI'),K(AP),SF(GOV),TDRV(VA2),SEM(STATE),CAT(V),SUBV(VING),TENSE(PRES),TVL1(N),
TTENSE(PRES).
NODE 12 'APPLICATION': UL('PRAYUK'),K(NP),SF(GOV),DRV(VN),TDRV(VN),SEM(PROG),CAT(V),SUBN(CN),NUM(SIN),TVL1(N),
TVL2(KAP).
NODE 13 '.': UL('.'),CAT(P).

***** ENGLISH-THAI MACHINE TRANSLATION PROJECT *****
****** THAILAND ********

STRUCTURAL GENERATION

RESULT OF EXECUTION ----- TEXT : CHEMI -> LANGUAGE(S) : EN2 - TH

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 1: 'ULTXT' (2: 'ULFRA' (3: '*VCL' (4: '*NP' (5: 'PATIKIRIYAA' (6: 'PATIKIRIYAA', 7: 'NII'), 8: 'NII',
9: '*NP' (10: 'PRAYUK' (11: 'PRAYUK', 12: '*AP' (13: 'SONGAI'))), 14: '.'))

1 ' ': UL('ULTXT').

   2 ' ': UL('ULFRA').

      3 ' ': UL('*VCL'),<(VCL),SLOCK(1),LOCK(1),SEM(STATE).

         4 ' ': UL('*NP'),RL(ARGU),K(NP),SF(SUBJ),TORV(VAL),SEM(PROC),KLOCK(1),SFLOCK(1),CATLOCK(1).

            5 'REACTION': UL('PATIKIRIYAA'),K(NP),SF(GOV),TORV(VAL),SEM(PROC),TVL1('I').

               6 'REACTION': UL('PATIKIRIYAA'),K(NP),SF(GOV),TORV(VAL),SEM(PROC),TVL1('I').

               7 'THIS': UL('NII'),SF(DES).

         8 'HAS': UL('NII'),K(VCL),SF(GOV),SLOCK(1),LOCK1(1),SEM(STATE),TVL1('I').

         9 ' ': UL('*AP'),RL(ARG1),K(NP),SF(OBJL),TORV(VAL),SEM(PROC),KLOCK(1),SFLOCK(1),CATLOCK(1).

            10 'APPLICATION': UL('PRAYUK'),K(NP),SF(GOV),TORV(VN),SEM(PROC),TVL1('I'),TVL2(KAP).

               11 'APPLICATION': UL('PRAYUK'),K(NP),SF(GOV),TORV(VA),SEM(PROC),TVL1(N),TVL2(KAP).

               12 ' ': UL('*AP'),RS(QUAL),K(AP),SF(ATG),TORV(VAZ),SEM(STATE).

                  13 'INTERESTING': UL('SONGAI'),K(AP),SF(GOV),TORV(VAZ),SEM(STATE),TVL1(N).

            14 '.': UL('.').
```
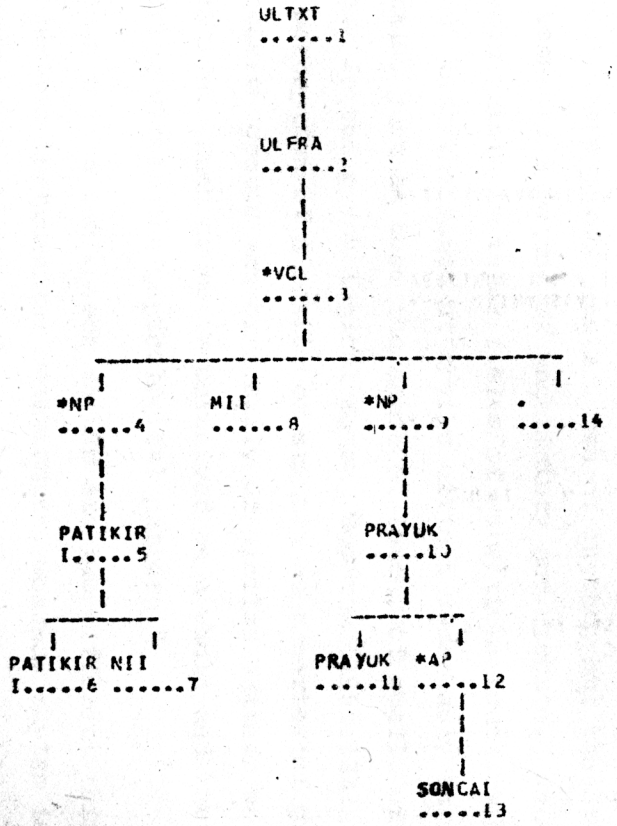

**** ENGLISH-THAI MACHINE TRANSLATION PROJECT ****
****** THAI(LAN) ********

STRUCTURAL GENERATION

RESULT OF EXECUTION ----- TEXT : CHEMI 6

LANGUAGE(S) : EN2 - THI



NODE 1 ' ': UL('ULTXT').
NODE 2 ' ': UL('ULFRA').
NODE 3 ' *: UL('*VCL'),<(VCL),SLOCK(1),LOCK1(1),SEM(STATE).
NODE 4 ' *: UL('*NP'),KL(ARGO),K(NP),SF(SUBJ),TORV(VN),SEM(PROC),KLOCK(1),SFLOCK(1),CATLOCK(1).
NODE 5 'REACTION': JL('PATIKIRIYAA'),K(NP),SF(GOV),TORV(VA),SEM(PROC),TVLL(TO).
NODE 6 'REACTION': JL('PATIKIRIYAA'),K(NP),SF(GOV),TORV(VN),SEM(PROC),TVLL(TO).
NODE 7 'THIS': UL('NII'),SF(DES).
NODE 8 'HAS': UL('NII'),K(VCL),SF(GOV),SLOCK(1),LOCK1(1),SEM(STATE),TVLL(TO).
NODE 9 ' *: UL('*NP'),KL(ARG1),K(NP),SF(OBJ),TORV(VN),SEM(PROC),KLOCK(1),SFLOCK(1),CATLOCK(1).
NODE 10 'APPLICATION': JL('PRAYUK'),K(NP),SF(GOV),TORV(VA),SEM(PROC),TVLL(1),TV2(KAP).
NODE 11 'APPLICATION': JL('PRAYUK'),K(NP),SF(GOV),TORV(VN),SEM(PROC),TVLL(1),TV2(KAP).
NODE 12 ' *: UL('*AP'),RS(QUAL),K(AP),SF(ATT),TORV(VA2),SEM(STATE).
NODE 13 'INTERESTING': JL('SONCAI'),K(AP),SF(GOV),TORV(VA2),SEM(STATE),TVLL(N).
NODE 14 '.': UL('.').

CHEMI 3 16 APRIL 1984 11H 50MN 47S

SOURCE AND TARGET LANGUAGES : EN2-THI

-- INPUT TEXT --

THIS REACTION HAS AN INTERESTING APPLICATION.

CHEMI 3 PAGE 2

-- TRANSLATED TEXT --

---- (TRANSLATION OF 16 APRIL 1984 11H 50MN 40S) -----
VERSIONS : (A : 14/02/84 ; T : 14/02/84 ; J : 14/02/84)

PATIKIRIYAA NII MII KAANPRAYUK NAASONCAI.